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THE BIG SPATHE BORING MOTH OF COCONUTS.

By H. W. SIMMONDS, F.E.S., Acting Government Entomologist.

This moth was bred out first by Jepson, from material obtained from Mr. Tarte's estate at Vuna, and more recently by myself, from material from the same estate. The moth is widely distributed throughout Fiji, where it does much damage, destroying the young inflorescence before the bud opens. The egg is laid at the base of the spathe, and the maggot bores through, leaving a small brown spot on the outside, and a brownish stain on the inside. It then burrows up amongst the young flowers, and nuts, completely destroying those it comes in contact with. As many as eight have been found in a single spathe.

When fully grown the larva bores a hole towards the end of the spathe, and emerges. It then makes its way to the ground, although it is uncertain how, and there pupates, forming an earthen cocoon. The pupa is armed with setæ, and shortly before ready to emerge, works its way up, and breaks through the end of the pupa case, and then comes right out before the moth emerges. The pupal stage lasts according to Jepson, 22–26 days; my own experience was double that time, so that there is probably considerable variation in the pupal period. When the pupa emerges from the cocoon it works its way, by means of its setæ, right to the surface of the ground, and often slightly projects, from which position the moth finally emerges. When in this position the pupa is liable to the attacks of birds, and it was noticeable in the island of Wailailai, that at the township where the ground was clean, there were no spathe borers present; whilst in an adjoining bay not 200 yards away, where the ground was overgrown, they were very bad. Possibly fowls helped to keep the village clean.

The perfect moth is dark brown with light borders and margins to the front wings, with a few irregular pale lines on them, the hind wings being plain. Antennæ heavily pectinated. The female differs from the male, not only in her larger size, and less pectinated antennæ, but is much darker, and lacks the pale margin to the front wings, and the markings on them are more broken, and of a golden rather than whitish colour, whilst the hind wings are also much darker than in the male.

The larva has very powerful jaws, and I have observed its borings right at the bases of big leaves, that it must have bored through on its way to the ground.

Specimens of the moth have been sent Home with a view to having it named.

COCONUTS AND BANANAS ON CERTAIN ISLANDS AROUND THE COAST OF VITILEVU.

By H. W. Simmonds, F.E.S., Acting Government Entomologist.

Partly with a view to seeing how far the ravages of *Levuana iridescens* (the coconut leaf moth) extended, and whether there had been any increase in the affected area during recent years, and partly to observe the condition of the bananas in the same group, a visit was paid to a number of islands in the Yasawa Group, and on the return journey Ovalau, Moturiki, Viwa, and Naigana were called at.

COCONUTS.

All around Lautoka the trees looked wonderfully well, with heavy heads of nuts, except just at the end of the wharf. Here there had recently been a very bad attack of the small leaf moth *Agonoxena argaula*, which however had not apparently affected the yield.

From Lautoka we made the island of Waia, in the Yasawas, and thence Waialailai, Naviti, and Yasawa, and on the return Yanuya and Malolo. On the whole of the islands from Yanuya northwards the trees were healthy, with good heads of nuts. One tree on Waia must have carried 200 nuts. A little spathe borer, and *A. argaula* were present, but not badly, whilst none of the mining beetles *Promecotheca reichei* were observed. At Yasawa drought was however affecting the trees a little, whilst at Naviti many of the outer leaves showed the affects of the recent gale.

At Naviti certain nuts were found in which a borer was at work around the calyx, and in one case had penetrated to the meat. A number of these nuts were brought away, and an endeavour will be made to breed it out. At Waialailai a complaint was made that unripe nuts kept dropping from a certain tree, and on investigation this borer was found to be present, and was probably the cause of the fall. At Waialailai it was noticed that the bay in which the town stood was absolutely free of spathe borer, and the trees were very fine, but at the next bay there was a very shallow soil, and the trees were small and unhealthy, and spathe borer was very prevalent. The small moth *Harpagoneura complena*, which also attacks the spathe was present at several places, and one was observed flying at Naviti. The small honey suckers which were very abundant, doubtless did much to hold this pest in check.

At Yanuya which was next visited, the trees were still good, and there was some very fine soil on this island. My attention was however called to a tree which was dying, and which I had cut down. A bad patch of fungus was found to be present near the head. The general symptoms of this tree resembled budrot; the outer leaves hanging down. The bud however was quite sound and no case of true budrot was found in the group. The portion of the trunk under the head which was diseased was on the outside brown, and dead with a line of black and yellow between the dead and healthy wood.

Cultures of the disease were obtained, and handed to the Acting Mycologist for examination. As however this tree was an isolated case, I am of opinion that this was the result of some injury, and that the fungus was purely a saprophyte.

LEVUANA IRIDESCENS.

The next island called at was Malolo, and here *Levuana iridescens* was present in immense numbers. Large numbers of trees were dead or dying, many hundreds in all. One patch showed six dead out of eight trees,

and that was not an isolated case. Only a very few good heads of nuts were seen, and I doubt if the average yield would exceed one nut to three or four trees. *Aspidiotus aurantii*, and a *Mytilaspis* scale were present, the latter heavily parasitised, and did no damage. Fires were frequent here, and on the adjoining islands did much damage. On inquiry I found that *Levuana* first appeared about five years ago, but the Buli stated that many years ago there was a disease present, which may have been the same, but which subsequently died out. On this occasion the disease first appeared at Malamala, next appearing at Naviti, and then at Malolo, and so to Naqualito and other small islets adjoining. We called at Naviti, where we found the wave of disease past, and only dead pupæ. Several of these had small circular holes as if attacked by a parasite, but all were dead. A number brought away and examined microscopically showed no trace of a *Hymenopterous* pupal case within the *Levuana* pupa, and I am at present of the opinion that the holes were made by some external insect after the pupa, which was already dead within. Further investigation should however be made next season.

This evidence of the recent spread of *Levuana* is interesting and somewhat alarming. It forms another reason for suspecting *Levuana* to be an introduced species; nevertheless a species subject to epidemic fungoid disease, and which requires considerable areas of land on which to successfully thrive. By the direction of its progress it probably travelled on the north-east wind, the Tukelau.

Mr. Kennedy of Ba informed me that on one estate which they owned at the mouth of the Ba River, trees bore heavily from 1871 to 1879, in December of which year it was swept by hurricane. The following year *Levuana* appeared, and has been present ever since. This may give the approximate date of its first appearance in that side of Vitilevu. Cottony cushion scale (*Icerya purchasi*) was also found to be present on Malolo.

SCALE DISTRICTS.

Ovalau and Moturiki were next visited, to see what effect, if any, the introduced parasites were having upon the scale *Aspidiotus destructor*. In all the areas visited a very big improvement was noticeable, and at Waidau many trees were found to be showing quite good heads of nuts again. At Bureta and Moturiki a certain number of the worst affected trees had died, and more will follow, but on most of the trees examined the scale was almost, if not all dead, and the trees were showing many fresh green leaves.

Examination of the scale showed that both parasites were working well, and that the fungus was also extensively present. A very large number had however been broken open from the top, in the manner characteristic of earwig attacks. Viwa and Naigani were also visited, and scale was present at both. The yellow chalcid *Aphelinus chrysomphali* had reached both these islands, and was doing good work, but the smaller *Aspidiotiphagus* had not yet reached these islands. At Naigani many trees had died as a result of the scale, whilst at Viwa *Levuana* was present, and bad in the central portion of the island. This probably marks the outer limit of this insect at present in this direction.

BANANAS.

In every island visited bananas were grown, and generally speaking looked healthy, but borer was present everywhere. The Yasawas are a very dry district, and when the borer was present it was more fatal than in the wet areas, so that when attacked by the borer the tree generally died.

Nevertheless a few were found in an intermediate stage, and these had all the symptoms characteristic of the diseased trees at Nasinu and elsewhere around Suva.

The varieties cultivated are hiefly *Vudi dina* and *Gros Michel* with a few *Blue Javas* and *Cavendish*. The natives were shown the borer, and advised as to the planting of clean suckers; also not to leave stumps on abandoned land, and so to starve out the beetle before replanting. Still throughout the whole group there was very little borer, and many fine heads.

At Ovalau I saw some very fine heads, and I have elsewhere advised that I consider this island the best I have seen for banana cultivation at the present time, and it seems to me it would be suitable for European cultivators in small blocks.

At Viwa a few bananas were grown, and should do well. No cultivation was however attempted, and the planters did not even trouble to powder the bunches, with the result that many bunches had fully two-thirds destroyed as table fruit by the attack of the small moth. This island is one that supplies fruit for export, and under these circumstances one can easily understand the complaints now being made as to the quality of our fruit.

Cercospora musæ was present everywhere, but only on old leaves, and did practically no damage.

As a result of this opportunity of seeing bananas growing in the outside portion of this group, I am now of opinion that the present diseased condition of bananas in the Suva district is purely the result of the attacks of the borer *Cosmopolites sordida*, and lack of proper nutriment in the soil, both of which it is possible to deal with under proper cultivation. If the so-called *Sigatoka disease* was due as supposed to *Cercospora musæ* this fungus is to-day present everywhere and doing no damage, and I feel confident that if growers will only plant clean suckers in land that has been kept clean of old stumps, trap and manure, they will again get good results without having to keep going further back. This opinion is different to that which I at first held, that there was some other detrimental agency at work besides this borer.

DRIED BANANAS.

By C. Harold Wright, M.A., F.I.C., Government Chemist.

In a former article on dried bananas in *The Agricultural Circular*, Vol. 2, No. 3, the yield of banana flour was given on page 50 as varying from 5·05 to 7·58 lb per bunch, but I now find that I under-estimated the yield. The above figures were arrived at by supposing that the number of bananas in a bunch varies from 100 to 150, and that the average weight of a single banana is 132·4 grams = 4·67 oz. av. The latter figure was obtained by using China bananas; but I have since found that the weight of a single green Gros Michel banana varied on one bunch from 5·7 to 8·3 oz., and that the average weight of 19 of these bananas was 7·05 ozs. The weight of banana chips obtained from 54 of these bananas (mostly from the upper hands) was 4¾ lb.

A far better way to find out the yield of banana flour per bunch is to calculate it from the weight of a bunch of bananas, which varies from 20 to 100 lb, with an average of 50 lb. I found that the banana chips are 17·3 per cent. by weight of the whole green banana. The whole bunch consists of bananas and stalk, but since this is only a rough calculation the weight of the latter can be neglected. Hence the yield of banana flour per bunch will vary from 20 × ·173 = 3·46 lb to 100 × ·173 = 17·3 lb, with an average of 50 × ·173 = 8·65 lb.

COMPOSITION.

Banana flour prepared as described in the previous article by grinding banana chips in a coffee grinder was analysed in the laboratory, and the analyses are given in the following table, which includes other analyses of banana flour for comparison:—

BANANA FLOUR.

No.	1.	2.	3.	4.	5.
Water	14·21	14·48	10·88	13·0	11·10
Protein	2·69	3·00	0·71	4·0	3·55
Fat	0·29	..	0·22	0·5	0·83
Carbohydrate	79·04	..	84·83	80·0	81·70
Fibre	0·85	..	0·72	..	1·50
Ash	2·92	..	2·64	2·5	2·23
	100·00	..	100·00	100·00	..
Nitrogen	0·43	0·48	0·114	..	..

In the above table Nos. 1 and 2 are the analyses of banana flour prepared at the Chemical Laboratory during the months of July and October respectively. No. 3 is an analysis of banana flour by H. M. Cousins, Director of Agriculture, Jamaica (W. Fawcett, *The Banana*, p. 110); and Nos. 4 and 5 are analyses of banana flour quoted by Fawcett, pp. 110 and 116, on the authorities of Dr. R. Hutchinson and Dr. W. Tibbles, respectively. It will be seen that my analysis (No. 1) agrees very closely with Mr. Cousins' (No. 3), with the exception of the protein. Mr. Cousins found 0·114 per cent. of nitrogen, corresponding to 0·71 per cent. of protein. In the sample of banana flour prepared in July, I found 0·43 per cent. of nitrogen (as a mean of 3 determinations, the actual values being 0·43, 0·42, and 0·44), corresponding to 2·69 per cent. of protein; and in the sample of banana flour prepared in October 0·48 per cent. of nitrogen, corresponding to 3·00 per cent. of protein. The percentages of protein I have found in these two samples are very similar to the quantities in the analyses given by Drs. Hutchinson and Tibbles.

Analysis No. 1 in the above table gives the composition of the banana chips prepared by drying the pulp of the green banana. I found that the latter contains 68·8 per cent. of water, hence its composition can be calculated from the above analysis. No. 6 below is the composition of the pulp of the unripe green banana found in this way and No. 7 is an analysis by Leucher given for comparison:—

PULP OF GREEN BANANA.

No.	6.		7.
Water	68·8	....	70·5
Protein	0·0	....	3·9
Oil	1·1	....	0·1
Carbohydrate ..	28·7	....	24·0
Fibre	0·3	....	0·4
Ash	1·1	....	1·1
	100·0	....	100·0

It will be seen that I have found far less protein than Leuscher, and of course more carbohydrate, since the latter is found by difference. Leuscher found 5·0 per cent. of protein in the ripe banana, but the writer of the article on Banana in Thorpe's *Dictionary of Applied Chemistry* from which the above analysis by Leuscher is quoted states that " American analyses show much less protein in ripe bananas than is given in Leuscher's figures, the average being 1·3 per cent." Thus Leuscher found 5·0 instead of 1·3 per cent. in the ripe banana; and if we suppose that the same error was made in the analysis of the unripe banana, then the correct percentage of protein in the latter is $1{\cdot}3 \times 3{\cdot}9 = 1{\cdot}0$, which agrees with my figures.

BANANA BREAD.

Banana flour contains far less protein than wheat flour, which contains on the average from 10 to 15 per cent. of this constituent. It also differs from wheat flour in not containing any gluten. It is owing to this constituent (really several proteins) that wheat can be used in making bread. Owing to the absence of gluten banana flour cannot be used alone in making bread; and if it is mixed with wheat flour it behaves like a weak flour.

Through the kindness of Mr. N. B. Casey, the Superintendent, Suva Gaol, who took great interest in the subject, banana bread was made at the Gaol from mixtures of wheat flour and banana flour. When mixed in equal quantities the loaves were small and flat, like those made from a weak flour. They had a crisp brown crust, but the interior was dark coloured, damp, and close textured. This bread had a distinct banana taste, and though its appearance was not attractive, it was appreciated by everyone to whom it was given. Bread was also made from a mixture of one-quarter banana flour and three-quarters wheat flour. These loaves were of far better shape; the interior was light and spongy, and was very similar to brown bread in appearance. Loaves of this kind of bread were sent to a meeting of the Council of Planters of Fiji on 2nd November; portions of this bread were given to a great many people, and I think that all who tasted it liked it.

PREPARATION OF BANANA FIGS.

Banana figs are prepared by peeling ripe bananas, cutting the pulp lengthwise and drying them in the sun or in a dryer. It is well known that an ordinary steel knife discolours many fruits; hence in my experiments a rustless steel knife was used both in peeling the fruit and cutting the pulp; and for the same reason all contact with metal was avoided during the drying. The pulp of each banana was cut into three or four slices to shorten the time of drying, but in Jamaica the bananas are generally cut into two slices. If the bananas are fully ripe and the slices are dried quickly in the sun they are yellow-brown in colour; if the bananas are not quite ripe they are whiter; and if the bananas are over ripe or the bananas are not dried quickly they are darker in colour, and in some cases become almost black. Hence to make banana figs of an attractive appearance only fully ripe bananas should be used, and they should be dried as quickly as possible.

The drying presents some little difficulty, as the slices on drying soon become very sticky. Attempts were made to dry the slices on brown paper, but the results were not at all satisfactory; enamelled iron plates and a sheet of glass were then tried, but under these conditions the slices dried on one surface only, and although they were frequently turned took a long time to dry. The most satisfactory method so far tried is to dry the slices on butter muslin. In my experiments the butter muslin was fastened with tacks to a framework made from a benzine or kerosene case, which can be seen at the Chemical Laboratory by anyone interested in the

subject. This arrangement has been found most satisfactory. When exposed to the sun and wind the bananas dry above and below at the same time and hence require very little attention; the framework can be very easily made and the muslin can be easily removed and washed. I can strongly recommend this method to anyone who wishes to prepare figs on a small scale for home consumption. Of course on a large scale a dryer would be absolutely necessary, so as to be independent of the weather. Another advantage of a dryer is that during the drying the slices would not be contaminated by flies and other insects settling on them. Owing to their sticky nature figs cannot be wrapped in ordinary paper; butter paper or biscuit paper can be used, but on a larger scale they should be packed in wooden boxes like Turkish figs.

YIELD OF FIGS.

The proportion of skin in a ripe banana, and the yield of figs were determined by weighing a whole ripe banana on an enamelled iron plate which had been previously weighed. The banana was then peeled and the peeled banana weighed on the same plate. The pulp was then cut into slices and dried in the sun on the same plate until the weight of the plate and figs no longer lost weight. As an average of six experiments, which agree very closely amongst themselves, I found that the skin of the ripe banana amounts to 29·4 per cent. by weight of the whole fruit, or in other words that the pulp is 70·6 per cent. by weight of the whole fruit. The figs are 31·0 per cent. by weight of the peeled banana and 21·8 per cent. by weight of the whole banana. From the above data the yield of figs per bunch can be calculated. A bunch of bananas weighs from 20 to 100 lb, with an average of 50 lb Neglecting the weight of the stalk, which is very small compared with the weight of the bunch, the yield of figs per bunch would vary from $20 \times \cdot218 = 4{\cdot}36$ lb to $100 \times \cdot218 = 21{\cdot}8$ lb, with an average of $50 \times \cdot218 = 10{\cdot}9$ lb.

PROSPECTS IN FIJI.

I think everyone will agree that there is a great wastage of bananas in Fiji. The number of bunches which ripen between shipments or are too ripe for a particular shipment must be considerable. Then too, large quantities of bananas on the upper Waidina and Wainimala are wasted because in certain states of the river they cannot be brought to Suva for shipment. And lastly there are the small bunches too small for shipment and the small fruit too small for packing in cases. With a little enterprise all this fruit which has so far been entirely wasted could be dried for export. According to W. Fawcett, *The Banana*, p. 254, the number of factories for the manufacture of banana figs in operation in Jamaica in November, 1912, was 11, and the output of these varied from ½ ton per week to 3½ tons per week.

In order to show what use could be made of rejects which so far have been considered as fit only for pig-food, I bought a case of bananas which were rejected from the "Tofua's" shipment at the beginning of November, and from them prepared figs. The bananas were of very poor quality, and there was no wonder that they were rejected; but the figs prepared from them are very similar in appearance and flavour to figs prepared from some very fine Gros Michel bananas. Both kinds of figs were handed round at a meeting of the Council of Planters held at Nausori, on 17th November, and many members preferred the former to the latter. This shows what use could be made of all the bananas too small for export, which so far have been absolutely wasted.

INTRODUCTION AND NOTES.

By H. W. Simmonds, F.E.S., Acting Government Entomologist.

A recent publication by A. H. Benson on the subject of the Banana in Queensland contains a large amount of information, much of which is not only applicable to Fiji; but I believe goes to the very root of much of our present unsatisfactory position in this industry.

By Mr. A. H. Benson.

Mr. Benson writes as follows: The banana industry in Northern Queensland is now practically extinct, at any rate as far as the export of fruit to the Southern States of the Commonwealth is concerned, and at present there is no indication of any recovery. I am of the opinion however that eventually the culture of this fruit will again become an important business in our tropical northern areas as the completion of our coastal railway system will open up larger areas of land that are in every way suitable, and that can be worked economically under a system of intensive cultivation, combined with judicious manuring—conditions that will secure the permanency of the industry, as distinct from those that prevailed formerly, when the practice was to depend on the natural richness of virgin scrub land, and once this had become depleted, to abandon it as no longer profitable. Southern experience has shown us that bananas can be grown successfully on old land when such land is properly treated . . . . . .

The banana is a gross feeder, requiring a soil rich in all essential plant food and well supplied with humus . . . . . land which though not naturally as fertile as rich scrub, can yet be made highly productive if put into a state of thorough cultivation, and systematically and judiciously improved by green manuring, combined with heavy dressings of artificial fertilisers, rich in essential plant food. . . . . The experiments conducted by the Department of Agriculture some years since on land that was considered to be worn out, at Buderim Mountain, ... amply proved this, as they showed that an expenditure of over £20 sterling per acre for manures was a good investment when the fruit was worth about 3d. per dozen; so that there is every encouragement to use manures extensively, when the price of the fruit is three or four times what it was then.

"There is another point I wish to impress on intending planters, and that is the necessity for exercising the greatest care in the selection of suckers for planting; and further, to see that such suckers are properly planted . . . . . .

"In selecting a sucker, always choose one with a well developed bulb, and a thick tapering stem; that produces upright narrow leaves, not broad flaccid leaves and that is the same size at the bulb as where the leaves start. Plant nothing but good healthy suckers, and if there is any danger from nematodes, treat them as presently described prior to planting, and see that they are properly planted; viz., in properly prepared holes, and at a proper depth which means that the top of the bulb should be not less than 3 or more than 6 inches below the surface of the ground . . . . . .

"In concluding I have also to draw attention to the necessity of carefully grading and packing the fruit, as now that we are sending the bulk of the Southern crop to the Southern States by rail, it will not pay to run any risk of not getting the best price by indifferent handling, grading, and packing."

By Messrs. A. J. Boyd, J. C. Brunnich, and H. Tryon.

" The production of the Northern plantations is only a fraction now of what it was fifteen to twenty years ago. Bananas were only planted in virgin scrub land, and the plantation seldom lasted more than six years, as the Chinese growers found it more profitable to take up new scrub than to attempt the thorough cultivation and manuring of land that had already been planted in bananas. The natural result was the supply of suitable available land became exhausted, and the falling off in the Northern output coupled with a shortage of Island production, resulted in a considerable rise in the price of the fruit . . . . . Owing to high prices there has been an inclination to plant bananas on land that older growers would have considered totally unsuitable; but even here bananas can be grown, provided they are properly fed, which means that the soil is kept supplied in humus by means of green manuring, and that an abundant supply of plant food is provided in the form of commercial fertilisers, or good farm yard manure . . . . . The question to be considered is, that all banana lands require manuring and heavy manuring at that, sooner or later, ... Bananas are frequently the first crop planted in newly burnt off scrub land, as on such land no special preparation is required, and the large amount of ash, and partially burnt and decomposed vegetable mould provide an ample supply of food for the planter's use. Bananas are rank feeders, so that this abundance of available plant food causes a rapid growth, fine plants and correspondingly large bunches of fruit. The best soil for the cultivation of the plant is a warm, well drained, but rather moist deep loam, with a good proportion of humus. . . . . Swampy land is quite unsuitable. . . . . In the cultivation of all soil for crops, the first and most important thing is to thoroughly prepare the land by deep ploughing, cross ploughing, harrowing and where necessary, sub-soiling.

" No matter how rich and even loose the soil may be, the previous preparation before planting will prove advantageous and labour saving in the after cultivation. In the case of newly cleared scrub land ploughing is of course out of the question, owing to the innumerable stumps, and the network of roots. In such cases all that is needed is to dig holes about 18 inches square and 18 inches—2 feet deep. . . . . The after cultivation, where the land has been previously well prepared by ploughing and harrowing, consists, in keeping the spaces between the young plants clear of weeds by means of the farm implements usually employed for such work amongst other crops. Once the plants have begun to bear, cultivation of the land usually ceases. One of the reasons given for this is that even very light ploughing or scarifying is injurious to the growing plants, which in loose soil, send their roots all over the unplanted spaces. . . . . .

" Mr. Higgins, in *The Banana in Hawaii*, says: ' Tillage is one of the important forces making for fine fruit.' It has commenced with the thorough deep ploughing and harrowing of the soil, and must be continued to keep the surface loose and free from grass and weeds, and for the many other benefits which follow in its train. This is correct in the case of cleared and stumped land as a good soil mulch must be maintained during dry periods but is not so necessary during the wet period of the year, when the growth of a cover crop will be found advantageous, as it will supply humus and nitrogen to the soil and tend to correct the injurious action of soil toxins.

. . . . . .

" Most of the time after planting, tillage of the surface soil only will be best. The subject of ploughing in an established plantation is still in dispute amongst banana planters. Mr. Higgins, says: that ' many of the roots of the plant are so near the surface that any ploughing deeper than a few inches would cut off a great many of them.' This may be an advantage or a disadvantage. The banana roots are not naturally branching, but run out long and cord like. Cutting of these roots causes them to send out many new ones from the cut surfaces, which spread in several directions, thus increasing the food-gathering capacity of the plant, as is claimed by some. The production of these roots, however, must make very considerable demands upon the stores of food in the corm and therefore ploughing should not be done at a time when all the supplies of stored food are required for the developing of the flower-bud or of the fruit. Basing their practice on this reasoning, many planters in the West Indies do not plough until after the main crop for the American market has been gathered. . . . .

" In dealing with the plants on a newly formed plantation, attention must be paid to the before-mentioned suckers. Whilst the plant is young all the suckers except one should be cut away, the best plan being to sever them with a sharp spade or a narrow sharp-edged grafting tool, such as is used in the final stage of making a pipe drain. Thus all the vigour of the plant is thrown into the fruiting of the first stem and the growth of the one to supplant it, and in this way fine large bunches can be reckoned on. Afterwards, when the stool has matured three stems may be allowed to grow. I previously pointed out on no consideration should a large number be permitted to shoot up, if fine bunches are looked for. The second stem usually produces a finer bunch of fruit than the first, but as time goes on and the land begins to show signs of exhaustion, the bunches decrease in size and this shows the necessity for manure in some form or other. After the stool has borne a crop or two, the earth should be loosened round the stems, and manure, decayed leaves, banana stems, weeds, or cover crop forked in, the whole being moulded up with surface soil from the vicinity. When the plantation shows signs of exhaustion, as it probably will after a few years, it should be stumped out. The land should be deeply worked and sown with a pulse crop, such as cow peas or other strong growing nitrogen and humus producing plant, which is to be ploughed in. The land so rested and improved can then be well manured, and replanted with bananas, which if the work has been carried out throughly, will do equally as well as if on virgin land. . . . . .

" The carrying out of manuring experiments in the Northern tropical district presents many difficulties and one series of experiments established by the Department of Agriculture and Stock, under the direction of the Agricultural Chemist had to be abandoned. Another series was started last year in the neighbourhood of the Kamerunga State Nursery, and this already has suffered from very adverse climatic conditions—an unprecedented spell of dry weather last year, followed by exceptionally heavy rains this year.

" Several manurial experiments carried out in Southern Queensland, under sub-tropical conditions, gave excellent results and demonstrated beyond doubt that exhausted banana land may, by thorough cultivation and the aid of heavy dressings of artifical fertilisers, produce crops equalling the crops obtained from virgin lands. . . . . .

With regard to the manuring of bananas the following may be quoted.

" Artificial fertilisers, more particularly potash manures give good results in banana culture in India.

" Lime is of great importance to bananas, and experiments in Panama

have proved the great benefits of liming soil in the cultivation of bananas. This is also proved by our own manurial experiments.

" Phosphoric acid is of great value, but more particularly potash must be supplied in liberal amounts. A number of fertiliser experiments reported by J. M. Hattrick as carried out in Queensland and in Fiji fully bear this out, and the authority quoted states: ' That for every 1s. spent on potash the planter receives 6s. in return . . . . . .

" The growing of green manure crops, like velvet beans, Mauritius beans, &c., is practised in some localities, and can be strongly recommended, as long as the cover crop is not allowed to grow too near to the stools, so as to prevent robbing the bananas of necessary moisture."

By Government Entomologist, Fiji.

I have quoted the above at considerable length, and I am of opinion that the conditions therein shown to exist in Northern Queensland are very similar to those which are found in Fiji to day, and that suggestions there put forward would if applied here, assist greatly in putting our own industry on a sounder footing.

It will be observed that great stress is laid upon humus and the necessity of green manure to supply this, also upon the further supply of artificial dressings such as potash, and also having produced the fruit, to grade it, and market it, in an attractive way. It seems to me that this applies equally to Fiji to-day. No industry which depends upon the constant opening up of new land is in a healthy condition, and to bring about permanence it is absolutely necessary to regain the fertility of the older soils by systematic cultivation.

Apart from the rejuvenation of the soil, by green manures, by liming, which releases potash, and also assists the production of nitrogen by the green crops, we have two other serious difficulties to contend with in Fiji, although both of these are also in Queensland.

The first is the borer. The only effective means of dealing with this so far has been found to be trapping. This is successfully done in Queensland, and Florida, and we have in 18 weeks at Nasinu captured no fewer than 15,378 beetles or 76·5 per stool. What this means to the plants can be imagined. So far as the present condition of the banana plants at Nasinu is concerned there seems to me to be nothing that cannot be fully accounted for by natural exhaustion of the soil, which was never a rich one, and the tremendous havoc worked by the borer, many of the corms being quite hollow and rotten. The effect of trapping here is already showing in the much more vigorous growth of many of the young suckers, and that despite the fact that there must still be vast numbers of borers present.

The other pest we have to contend with is the eel worm (*Tylenchus*). This is also present in Queensland and Jamaica, and the following course is recommended by the author previously quoted.

" To prevent any soil from an infested area being transferred to a clean area.

" To obtain sound healthy plants.

" To disinfect all plants before planting by steeping them in a solution of corrosive sublimate, made by dissolving 1 oz. of corrosive sublimate, made in 6 gallons of water, for a period of at least two hours. Use a wooden cask, not metal.

" Prevent the formation of surface roots as much as possible. Maintain the vigour of the plant by heavy manuring and good cultivation, as strong plants will frequently be able to withstand the disease where a less vigorous plant would succumb."

BUD-ROT IN TAVIUNI.

By H. W. Simmonds, F.E.S., Acting Government Entomologist.

A comparison of the present outbreak of bud-rot in Taviuni with the West Indian outbreak as described by J. N. Johnson in 1912, and later by S. F. Ashby in 1920, should prove of interest to our growers.

Johnston states that the disease in Cuba seemed to be more violent than elsewhere. At Baracoa a grove of 400 trees of which only about a dozen were infected when first seen, were found a couple of years later, to have been completely destroyed, and that was not an isolated case. The areas where the disease was bad in Cuba were generally neglected, or interspersed with bananas, cacao, taro, &c. In contrast to this cultural conditions were much better in Jamaica, no underbush being allowed, and the disease seemed well under control. It is believed says Johnston that the few planters in Jamaica, who have the disease in their coconut groves do not cut down on an average more than one-tenth of one per cent. of their trees annually. At one place, viz., Nigril Point, however, where the trees had been neglected the disease was progressing, and the grove seriously affected. In Jamaica, Johnston states: "that bud-rot has been put under control by keeping the diseased trees cut down and burnt." In Trinidad bad drainage was an assisting cause apparently, although Johnston was of opinion that whilst some root disease was present, it was not the actual cause of the bud-rot, which was due to separate infection. In the Sipara district where there had been great loss from the disease, swampy conditions again prevailed. Porto Rico seemed free from the disease, and Johnston suggested that the importation of seed nuts from other islands be prohibited.

There were certain points in which the diseased trees resembled the Fijian ones, which were not mentioned in my report on my recent visit to Taviuni. One was the presence of black spots at the bases of the leaflets, although the description of these did not seem quite the same as Fijian ones. The presence of large numbers of earwigs was also characteristic, and it is of interest that Johnston obtained pure cultures of *Bacillus coli* from the bodies of those earwigs from infected trees.

In the West Indies flaming of the trees, and also spraying were tried, but the evidence of both pointed to absolute failures. The only successful treatment was to cut out quickly all infected trees.

CAUSES OF BUD-ROT.

Johnston produced a similar disease to bud-rot in coconuts from pure cultures of *B. coli* taken from an affected tree and inoculated into palms grown under glass in New York, thus demonstrating that a bacillus of the *coli* group which was found to be present always in diseased trees, could in inoculation bring about a similar diseased condition to that found naturally on these estates. There seems to me little doubt that such disease would require to be inoculated in order to affect the trees, and therefore that the inoculating agency must pass from diseased to healthy trees.

More recently Ashby has carried out a series of investigations in Jamaica, in which he shows that the primary infection is due to a fungus *Phytopthora palmivora* (Butler), which first breaks into the healthy tissue, thus opening the way for *Bacillus coli*, which actually causes the rot and putrefaction of the central core. Einking has also shown that a species of *Phytopthora* was the primary infective agency in the Philippines, whilst Butler and Shaw found a similar agency at work in India.

As the form of bud-rot in Taviuni was of the same type as those described in connection with these fungi, *i.e.*, the central heart rotted leaving the outer leaves and ring of nuts apparently healthy, a further examination of the material brought from Taviuni was made, with a view to seeing if our outbreak was also connected with *Phytopthora*. An appended report by Dr. Carment shows that such is the case, *Phytopthora sp.* being present in each example.

In view of this we can now understand why the disease follows principally along the strip of land at the bases of the foothills *i.e.*, the region of continuous rainfall, and frequently of poor drainage.

Ashby shows that bad outbreaks generally follow on period of exceptionally heavy rainfall after a lapse of 2–7 months, and also after hurricanes.

Fungicides were tried in Jamaica, but a severe hurricane put a stop to the experiment, although in some estates good results were shown. It is intended to carry out further investigations in Taviuni, and endeavours will be made to locate a primary infection, before the rotting stage has been reached.

FUNGOID DISEASES OF COCONUTS.

By Dr. A. G. CARMENT, Government Mycologist.

Bleeding disease of coconut stems at Cicia, sample taken under strictly sterile conditions by Mr. Simmonds, has been under cultural examination for some time, and shows the presence of one fungus only. It consists of branching mycelium with aerial hyphæ of two types.

1. An ordinary septate conidiophore, the terminal cell of which is the largest, extrudes endoconidia which remain in short chains (two or three aerial hyphæ may join to form one conidiophore).

2. At the junction of two or more filaments of mycelium a round swelling appears from which a non-septate stalk arises and ends in a bulb (as pycnidium) in which round spores can be seen; these travel upwards and are extruded from the bulbous extremity.

In all points the fungus corresponds to a *thielaviopsis*, a species of which is known to attack pineapples and coconut trees. So far this fungus has not been mentioned as occurring outside of India, Ceylon, and the West Indies.

Many months ago I also received from the same source a piece of diseased coconut stem collected on Vanualevu on which an almost similar fungus was grown. This is the disease reported upon in June number of the *Agricultural Circular*.

FUNGI COLLECTED BY THE ENTOMOLOGIST IN THE YASAWAS.

1. Coconut leaf with circular centrally depressed areas, yellow-brown on the petiole, and elliptical patches on the leaflets. A hanging drop culture showed a branching mycelium, in which the septate were not complete; the threads of the fungus anastomosed freely and a few short aerial hyphæ with terminal sporangia were seen.

2. A tube of media inoculated by the Entomologist from the trunk of a coconut, in which saffron coloured growth of fungus was found consisting of branching threads with clusters of large spores occurring along their whole length; and in close association with this were short chains of oblong and oval cells; these cells contained the colouring matter and looked like a torula.

3. From Malolo, a tube of culture media also inoculated direct by the Entomologist.

Low power microscopic examination of the growth showed it to be a septate mycelium with aerial hyphæ on the sides of which could be seen short stalked sporangia packed with spores, also chains of spores.

It was noticed that as soon as water touched these sporangia they burst and the spores were scattered. In hanging drop culture the spores appeared as oval bodies and germinated rapidly and the mycelium was non-septate except in the older parts of the growth.

COCONUT DISEASE OF BUD-ROT.

While investigating a case of this disease recently, I had occasion to make an anærobic culture to verify the presence or otherwise of a bacillus of the *Coli communis* group. In this culture a fungus was found growing which on further examination appears to closely resemble *Phytophthora palmivora* recently described by Butler as a cause of bud-rot. The points of similarity were, (1) short stalked sporangia; (2) intercalary masses of spores in the course of a mycelium thread or at a node; (3) the spores found were all chlamydospores.

Cultural samples of all the above have been sent Home for identification to the Imperial Bureau of Mycology.

PEDICULOIDES VENTRICOSUS AS A PARASITE OF LEVUANA.

After spraying young coconut trees attacked by *Levuana iridescens* with emulsion of a fungus clusters of dead pupæ were removed and examined; from some of them the original fungus was obtained by placing dead pupæ on culture media, however, on opening many cocoons in which dead pupæ were found and examining with a strong magnifying glass many mites were observed.

These proved to be *Pediculoides ventricosus* which are known to feed on animal and plant juices and are commonly found on cereals. From the large number of pupæ attacked it is probable that in these we have another destroying agency of the *Levuana iridescens*.

A FUNGOUS PARASITE OF THE HORNET.

By Robert Veitch, B.Sc., Entomologist to the Colonial Sugar Refining Company.

During May of the present year the writer was engaged on entomological investigations at Nausori and in the course of his work in the sugar-cane fields large numbers of hornets (*Polistes hebræus*, F.), were noticed in a dying condition and many dead specimens were found clinging to the cane leaves. All these specimens were attacked by a fungus which has now been identified by the British Museum authorities as *Isaria crinata*, Felton, a fungus first recorded from the West Indies; the same authorities also state that the fungus is undoubtedly a true parasite, *i.e.*, it is actually the cause of death and not merely a saprophytic fungous growth on insects really killed by age or by some disease. The number of attacked specimens at Nausori was large enough to justify the recognition of the fungus as an important factor in determining the abundance of the hornets. In some instances long sprouts of the fungus, sometimes as much as an inch in length, were found growing out of every suture (a suture is the line of junction between two distinct parts of the body wall); in other cases these sprouts were quite short or almost absent.

In May the nesting season is just about over and many of the hornets have deserted their nests preparatory to the mating and hibernating of the females; it was at this stage of the insect's life cycle that the fungus was found, but further observations may show it to be equally active at other stages of the life history. A large proportion of the attacked hornets were females and so the number that would hibernate and start fresh nests in the following October was considerably reduced; the parasite therefore acts as a check on the multiplication of the hornet in the Nausori district, and its presence is certainly of some considerable importance. This is not the only time that a fungus has been observed attacking the hornet because both Mr. Jepson and Mr. Simmonds informed the writer in the course of conversation on the subject that they had observed a similar fungous attack; in each of these cases the same species of fungus was probably under discussion.

The fungus has not yet been observed on hornets in the dry districts of Fiji, but a very closely allied species attacks the small black bug (*Brachyplatys pacificus*, Dall.) that lives on Mauritius bean and on many leguminous weeds in the Lautoka district; on identification this species may prove to be the same as the one attacking the hornet at Nausori, and if that is so the hornet is almost certain to be similarly attacked in the dry districts; this, however, is a matter for further investigation.

The opinion expressed by some Rewa residents that the hornet has greatly decreased in numbers in recent years is probably correct and it is likely that the fungus under discussion is the cause of that decrease.

Since the above notes were compiled, Mr. Simmonds has informed the writer that he found this fungus to be very common on hornets at Waidoi during the earlier months of the nesting season; dead hornets were actually found clinging to the small nests. This observation indicates that the parasitic fungus is active throughout the year and not at one season only.

PACKING AND MARKETING CITRUS FRUITS.

There are few, if any of us, who have arrived at the stage of perfection either in the care of our orchards or the picking and packing of our fruits. We all know, or should know that a starved orchard cannot possibly be a profitable one; and yet there are growers who go on from year to year until the soil becomes so impoverished that they are reluctantly compelled at last to admit that fruit-growing under these conditions does not pay, and the treatment necessary to bring the worn-out orchard into condition would be too expensive for them to undertake. In the first place, why allow the land to become run down? Some will answer that their soil was always poor. Then why embark in fruit-growing on such soil, unless the person doing so is competent to undertake the treatment of such soil? We all know that the man who is heavily handicapped at the beginning usually has an up-hill task to keep pace with his more favoured neighbour who has started on good sound lines by purchasing good land and planting it with some of the best known commercial varieties of fruits. He has also given the cultivation his most careful attention and the spraying of trees for pests, and has attended to the up-keep of the land, with a clear understanding that it will not do to take everything from the soil and give it nothing in return. The result with this class of grower is that his trees produce crops of the quality of fruit which finds ready sale on the markets at top prices, while his unfortunate neighbour has a difficulty in finding a purchaser for

his indifferent fruit, and has to accept about half the price obtained by the careful grower, who has made a business of looking after his place, as before stated.

The reader may ask what connection have the above remarks with the packing and marketing? Well, they have nothing beyond the fact that the man who does not grow the best fruit cannot possibly market any, and he should not be disappointed if his agent does not get good prices for it, nor has he any just cause of complaint if he finds that he is making only a bare living from fruit-growing.

In marketing fruit there are several important things which must receive careful attention, and these we proceed to briefly point out.

In picking the fruit see that the work is carefully done, so as to avoid bruising or damaging in any way. If it is citrus fruit that is being picked, proper clippers for the purpose should be used. With these the stems can be cut off close to the fruit without the slightest risk of cutting the latter, but where ordinary pruning shears are used there is always a risk of cutting or puncturing the skin with the points of the blades. If fruit is intended for export it should be cut from the tree, and not pulled.

Cases should never be filled so full that when one is stacked on the other the top fruit will be bruised. If there are any rough roads to be traversed, spring carts rather than drays should be used, else the fruit may be shaken about and bruised.

Damaged or bruised fruit is always the first to decay, and when once a specimen becomes rotten in a box, there is always a great risk of many more surrounding it going bad also.

GRADING.

It is essential to the best results that all fruit should be graded evenly for size, colour, and quality. For instance a 2½ inch fruit should not be packed in the same box as fruit 2¾ to 3 inches in diameter. Again, bright and dull fruits, although of the same size should not be packed in the same case. In the case of oranges, a soft or rather thick and loose skinned or puffy specimen should never be packed with a firm orange as one spoils the appearance of the other. Scarred or thorn pricked citrus fruits should never be exported, as the cost of sending poor, or badly graded, ill-selected fruit is just as great as that of well selected, sound, good fruit; and while the chances are that the former fruit may make a loss for you out of the shipment, the good fruit is your only hope of success.

PACKING.

See that only one grade is put in any case, in order that the fruit should all be of the same size, quality, colour, and should be neatly wrapped. Proper wrappers can be purchased by the thousand for the various sized fruits, and a 2½ inch fruit should not be wrapped in a paper large enough to accommodate a 3-inch fruit, nor should a 3-inch fruit have a wrapper put on it which has been cut to fit a 2½-inch specimen.

The following will be found the right sizes for the different fruits:—

WRAPPING PAPERS.

How the different sized sheets can be most economically cut up:—

Size of sheet,	20 × 30, cuts	8—	7½ × 10,	3,840 to ream.
Do.,	20 × 30, cuts	6—	10 × 10,	2,880 do.
Do.,	24 × 36, cuts	12—	8 × 9,	5,760 do.
Do.,	24 × 36, cuts	8—	9 × 12,	3,840 do.
Do.,	24 × 36, cuts	6—	12 × 12,	2,880 do.

ORANGES.

Size of fruit, inches in diameter.	*Size of paper, inches.*
3½	12 × 12
3¼	12 × 12
3	12 × 10
2¾	10 × 10
2⅝	10 × 8
2½	10 × 8
2⅜	10 × 8
2¼	8 × 8

New South Wales Department of Agriculture Bulletin.

BANANA FIGS.

A form in which the banana may be concentrated is banana "figs." These are simply the dried ripe fruit. It is a well known fact that dates are the chief source of sustenance to the people in the countries where they are grown, as is also true to a large degree of dried figs, while the dried fruits of the more temperate climates such as apricots, prunes, raisins, &c., are taking an increasingly large place in the dietary. A comparison of the dried bananas with some of these as shown in the table below indicates that dried bananas, although somewhat lower in carbohydrates, are richer in protein than any of the others and are slightly excelled in fat content by raisins and dates only. In preparing dried bananas, the ripe fruit only is used, the starch having become converted into sugar which acts as a preservative. The fruits may be either sun-dried or submitted to one of the various processes in use for extracting moisture including evaporators, vacuum driers, &c. Dried bananas have been prepared in Hawaii on a small scale by the late William E. Rowell and possibly by others, showing that the Chinese variety grown here responds favourably to this treatment.

There is at present no large market for the dried bananas, but in case of an emergency, it would be possible to dry large quantities of the fruit thus making a concentrated food containing practically as much protein as brown bread and a larger amount of carbohydrates.

DRIED BANANAS COMPARED WITH OTHER DRIED FRUIT.

Dried fruit.	Refuse.	Water.	Protein.	Fat.	Carbo-hydrate	Ash.	Fuel.
	%	%	%	%	%	%	%
Bananas	..	29·2	5·3	2·3	57·9	5·3	1,240
Dates	10·0	15·4	2·1	2·8	78·4	1·3	1,615
Figs	..	18·8	4·3	0·3	74·2	2·4	1,475
Raisins	10·0	14·6	2·6	3·3	76·1	3·4	1,605
Apples	..	26·1	1·6	2·2	68·1	2·0	1,350
Apricots	..	29·4	4·7	1·0	68·5	2·4	1,290

Bulletin No. 6, Hawaii Agricultural Gazette.

WEST INDIAN DRIED BANANAS.

Ripe bananas were peeled, and gently heated in the Chula drier at a temperature of about 150° F. for sixty-four hours, until they reached a firm consistency, and could be rolled around the fingers without breaking or sticking. Free ventilation was provided throughout the drying to prevent cooking. Another sample was sun-dried, the process taking five days to complete.

These samples were forwarded to the Imperial Institute, London, for commercial valuation, and were favourably reported on as follows:—

" The samples of dried bananas, which are the subject of this report, were forwarded to the Imperial Institute by the Under Secretary of State, Colonial Office, and are referred to in his letter No. 22409/1919, of 28th April, 1919, enclosing a copy of letter S.S. 853, dated 25th March, 1919, from the Commissioner of Agriculture for the West Indies.

" It was stated that the samples had been prepared experimentally by the Agricultural Superintendent, St. Lucia, and it was desired to ascertain their quality and commercial value in the United Kingdom."

DESCRIPTION OF SAMPLES.

The samples consisted, respectively, of sun-dried and artificially dried bananas. The sun-dried bananas were in excellent condition, pale in colour, and of good appearance except that the netting used as a support during drying had produced deep markings in the fruits.

The bananas which had been artifically dried in a drying apparatus were distinctly inferior to the sun-dried sample. The fruits were very dark in colour on the side which had been in contact with the netting used as a support, and this defect would detract from their value.

COMMERCIAL VALUATION.

The samples were submitted for valuation to fruit merchants in London, who considered the sun-dried bananas to be good quality and worth 6d. per lb wholesale in the United Kingdom (July, 1919).

The flavour and quality of the machine-dried bananas were pronounced to be quite satisfactory, but such dark-coloured fruits would probably not be saleable when lighter-coloured fruits like the sun-dried samples are available. If however the darkening in colour would be avoided they would be as valuable as the sun-dried bananas.

These bananas from St. Lucia are somewhat larger than those now selling in the United Kingdom. The latter are of about the same colour as the sun-dried sample, and realise 6d. per lb wholesale whilst some lighter-coloured fruits have recently been imported, and are being sold at prices ranging up to 10d. per lb.

Before the war, dried bananas sold at 3½d. per lb wholesale in the United Kingdom but during the war the price reached 2s. 6d. per lb. The importation has rapidly increased but the future demand and price will depend upon the price of fresh bananas, which at present is high. When abundant supplies of cheap fresh bananas again become available, the demand for the dried fruits will fall, but there will always be a certain outlet for them as the trade has now become established.

REMARKS.

These sun-dried bananas from St. Lucia are of good quality, and consignments of similar character would be saleable in the United Kingdom. The

artificially-dried fruits were inferior to the sun-dried on account of their dark colour, and it would be desirable to carry out experiments with a view to obviating this defect. The lighter the colour of the fruits the higher will be their market value in the United Kingdom.

It is not advisable to pack bananas in ordinary paper, as it adheres to the fruits; "biscuit" paper or some form of grease-proof paper would be more suitable. It may be mentioned, however, that dried bananas usually arrive on the United Kingdom market in wooden cases, each containing ½ cwt. of bananas packed in layers, without any wrapping material.

The fruit merchants who valued the samples, stated that they would be willing to receive a trial shipment of about ten ½ cwt. cases of dried bananas from St. Lucia, provided that the quality was not below that of the present sun-dried samples. Information should therefore be furnished to the Imperial Institute as to the possibility of forwarding this quantity for sale.

COST OF PRODUCTION.

In these trials, 30 lb of ripe bananas were used. The skins when removed weighed 7½ lb, thus leaving 22½ lb fresh banana. The dried banana weighed 6½ lb. On this occasion the bananas were purchased at 1d. per lb. The original cost was therefore 2s. 6d. If the dried product of this trial sold at 6d. per lb on the spot, without further charges of packing, freight, &c., it would just leave a profitable margin. The dried product at 6d. per lb would realise 3s. 1½d. leaving a difference of 5½d. per lb which sum would have to cover labour in handling, loss from decay, and cost of fuel. If large quantities were handled, the cost of drying and handling would be greatly reduced.—*Annual Report, Department of Agriculture, St. Lucia.*

PROPAGATING BREADFRUIT ROOT CUTTINGS.

The cuttings are, here, inserted from the latter part of May through June to July, which at Lamao marks the close of a long dry season and the beginning of the rainy period. With proper treatment up to 80 per cent. of the cuttings made during this period will make healthy plants, but made at any other time of the year very few cuttings will grow.

The successful rooting of the cuttings at the time indicated is probably due to the fact that during the prolonged dry season and the consequent cessation of growth of the tree much of the sap had gradually been withdrawn from the top and stored in the roots. They are supercharged with vitality so to speak at the end of the dry season. The elaboration of the stored and concentrated juices of the plant, which is stimulated by the absorption of moisture from the rooting medium, then gives rise to the adventive budding of the roots.

If the explanation of the rooting and adventitious budding of the roots is correct, it follows that in other parts of the tropics the cuttings should be inserted at the end of the dry period notwithstanding when it occurs during the calendar year.

In nursery practice it has been found best to dig out the soil in a plant bed to a depth of 8 inches, and fill it with clean sharp medium coarse sand. A sandy loam may be used but this is less satisfactory. The sand should be levelled, saturated with water and tamped down as hard as possible. The roots of the tree are then dug up carefully so as not to injure them. They should not be allowed to become dry while they are exposed in the air and should not be allowed to lie exposed to the sun.

At the point of severance from the tree the roots should not be more than 2 inches in diameter, especially if several roots are dug, and it is a better practice to use many of the smaller roots for cuttings than to cut one or two large ones near the trunk of the tree. The small wounds are more quickly healed and there is less danger of the tree being uprooted by typhoons. The stump of the root should always be cut smooth and the wound carefully painted with coal tar before it is again covered with soil to prevent decay and entrance of termites. So many roots should not be removed from a tree that it is severely injured.

The entire length of the root, even to portions no thicker than a lead pencil, may be made into cuttings. Still smaller roots than that have been rooted at Lamao, but the plants are not so vigorous as those grown from bigger cuttings.

The roots should be sawed off into cuttings 8 to 10 inches long and the wounds trimmed smooth with a sharp knife. While not imperative it is a good practice to paint the wound on the thickest end of the cutting with a coal tar or white lead. Then a trench should be made in the sand bed and the cuttings inserted diagonally, so that the thickest end of the cutting is from one to at most two inches above the surface of the bed. It is best not to place the cuttings closer than six inches apart in the row, or the rows less than one foot apart, so as to avoid injury to the rooted cuttings when they are removed from the cutting bed. The trench should be made large enough so that the cuttings can be inserted without injury. They should never be bruised by pushing or forcing them down into the sand.

The sand should be packed as hard as possible about the cuttings and the bed well watered. If this has not already been done a bamboo shed finally erected above the cuttings to protect them from excessive sunlight.

After the cuttings are inserted the sand should not be kept saturated by daily applications of water, for then the sand frequently sours and the tiny roots rot off as they appear. The watering should not be repeated until the sand is dry, say once in 5 to 7 days. On the other hand it is beneficial to spray the cuttings with water twice or thrice, just enough to wet them, during the hot dry days before the rains appear, or to spread damp sacking over the cuttings during the hot part of the day, always removing it at night. This is, of course, not necessary when the rains begin to fall and the atmosphere is moist.

The sprouting of the cuttings is sometimes very irregular. Occasional cuttings will be ready for removal from the cutting bed in the course of two months after insertion, while others barely sprout in five months. The majority will be large enough for removal and transplanting to the nursery or into bamboo tubes or baskets at the age of seven to eight months, and with good care the plants are usually large enough for transplanting into the fields six to seven months later.

When transplanting is performed about three-fourths of the leaves should be cut off in order to reduce excessive transpiration of water from the plants, which should not be set out deeper than they grew in the nursery.

In the orchard the breadfruit should be spaced from 33 to 40 feet apart depending upon the fertility of the soil and the abundance and distribution of the rainfall.

With a thought of the pecan and other nuts which are becoming so extensively grown in the United States, some one there has said that " tree farming is the farming of the future." This is a thought of not little significance for the Philippines, indeed, for any land where the breadfruit can be grown.

It is not claimed that the planting of breadfruit would be a "cure-all" for our annually recurring food shortage, in many parts of the islands actual famine, but it is undeniable that if every farm-stead had a dozen or more well cared for breadfruit trees, the fruit produced would go a long way towards warding off want and famine in times of scarcity of other food. And the space occupied and the care required to bring the trees into fruiting and subsequently to maintain them in good bearing condition would be very slight. The trees would remain unaffected by locusts and other plant pests and even in the regions where the dry season is exceptionally long if they were properly mulched they would require very little water. Over the greater part of the islands no irrigation whatever would be required. For all the above reasons the extended planting of breadfruit trees is strongly recommended. And—

The great world powers with tropical possessions—the United States, France, and England—have numerous war craft constantly cruising the oceans for training purposes. Could it not be arranged when one of these vessels is despatched on a cruise in the South Seas, to have on board a trained agricultural explorer familar with the breadfruit to bring from the remote region to the other parts of the tropics the superior breadfruit varieties growing in the South Sea Archipelagoes, which, since the native populations are fast dwindling away, may otherwise soon be lost to civilisation forever? Again, it would be a benevolent enterprise that should appeal to the imagination of some philanthropist intent on serving his fellowmen.

It would appear that there is a unique opportunity for some one in authority or for some one with the means to do so, to perform a service to mankind of far reaching value combined with no little romantic interest.—*Philippine Agricultural Review.*

LEVUANA IRIDESCENS.

By H. W. Simmonds, F.E.S., Acting Government Entomologist.

In the patch of *Levuana* affected trees in Gordon Street which have been under observation for some time another enemy has now been observed feeding upon the half-grown larvæ of this moth. This is the young of a heteropterous bug several of which were observed sucking the juice from larvæ which had been apparently poisoned by the thrust of the proboscis.

These predatory enemies of *Levuana* are of interest, but their effect is not very great, apparently, and at present the fungus disease is the only influence exerting any real control of the pest and that is not sufficient to be of any real use.

A LARVA WHICH DAMAGES PARA GRASS.

By H. W. Simmonds, F.E.S., Acting Government Entomologist.

A number of larvæ were brought to the Department from the Navua district which we were informed were doing much damage to Para grass. These have been bred out now and prove to be *Heliothrix armigera*; a moth which is found over practically the whole world and does damage to many crops including cotton bolls. Probably its most effective enemies are small birds.

KIKUYU GRASS.

O. Stapf in *Kew Bulletin.*

In 1911 Mr. J. Burtt-Davy received from Mr. David Forbes of Athole, Amsterdam, Transvaal, a single root of a peculiar grass which he had collected on the shores of Lake Naivasha, Kikuyu, whilst hunting there, the grass having attracted his attention by the partiality which the wild game showed for it. The root was transplanted in one of the plots of the Botanical Station at Groenkloof, Pretoria, and soon established itself. It has since flowered there regularly every year, but not seeded, the original plant and its descendants being apparently all functionally female. In *The Farmer's Weekly* of March 23rd, 1917, Mr. H. A. Melle published a fuller account of the grass as it presented itself under cultivation, the greater part of which is reproduced here.

" Kikuyu grass (*Pennisetum longistylum*), says Mr. Melle, is a perennial, running grass, and like the ' kweek " forms a dense turf. It has branching leafy stems. The leaves are flat and spreading. Kikuyu has numerous stout rhizomes, as thick as a lead-pencil, and by the growth of these a single plant may cover an area of several square yards. If grown in a vicinity where there is not much moisture it will make very little top-growth, but will send out shoots and spread along the ground and establish itself firmly. But in the presence of moisture it will put on top-growth. I have seen it grow 2½ to 3 ft. high. As yet it has not been observed to set seed in South Africa although it flowers regularly at the Groenkloof Botanical Station every summer.

" Kikuyu is a summer grass, but will remain green until the first severe frost and will start growing again long before the veld grasses. At the time of writing our mealies have been scorched by frost and the veld grasses have become coarse and dry; whereas the Kikuyu is still putting on growth and is beautifully green and succulent. Its drought resistant qualities have proved to be equal if not better than any of the other grasses.

" Kikuyu may be considered as essentially a pasture grass. In districts where the rainfall is over 30 inches it might be possible to get two or three cuttings a season. What number of plants it can carry per acre has not been ascertained, but it will probably carry more than any other grass owing to its dense and rapid growth, combined with its resistance to eradication. If a sod of this grass be taken up, a few rhizomes (underground shoots) are always left in the ground; these in two weeks' time will send out green leaves and soon re-establish themselves.

" As Kikuyu can only be propagated by roots or runners the initial cost of establishing a pasture would be more than other grasses that bear seed. This, however, is compensated for by the fact that when it has been put in, provided there is sufficient moisture in the soil to start it growing, it will take care of itself. There is, moreover, no fear of it becoming choked by weeds. Although Kikuyu is such a hardy and vigorous grass it would be advisable to well prepare the ground previous to planting as it will then strike immediately and have an advantage over any undesirable plant.

" (*a*) Palatability.—I can say with every assurance that Kikuyu is one of the most palatable grasses. All stock eat it greedily and will leave most grasses to get to it. If stock are allowed on a patch of Kikuyu it will be seen that they will graze contentedly, and when they have had their fill they

like to lie down on it, for the Kikuyu forming such a dense turf provides a very comfortable rest.

	Air-dried.	
	Kikuyu grass.	*Guinea grass.*
Moisture	8·29	8·02
Protein	12·36	9·03
Carbohydrates	35·06	28·63
Fat (ether extract)	1·7	1·68
Crude fibre	33·08	40·54
Ash	9·42	12·10
Containing true protein	8·31	7·09
Nitrogen	1·977	1·445
Albumenoid nitrogen	1·330	1·134

" Kikuyu grows well on any kind of soil but thrives best on moist vlei soil. We have it growing on alluvial vlei, on heavy clay loam, on gravel clay, on red loam, and poor impoverished stiff clay. On all these it is doing remarkably well. It is also known to do remarkably well on sandy soils.

" Like all other grasses Kikuyu has also its disadvantages, and amongst these the chief are:—

" (1) It is a summer grass as it does not remain green throughout the winter, unless watered and not subjected to frost.

" (2) As it does not appear to form seed in this country, the only means of propagating it is by runners, hence freight, which involves additional expense. And it may happen that when it reaches its destination the ground prepared for it may not have sufficient moisture to start it growing. Although this is enumerated as a disadvantage it may also be considered as an advantage; yielding no seed there is no fear of it establishing itself voluntarily in an adjoining field.

" (3) Being such a hardy and persistent grower when once established it will be very difficult to eradicate. We have a good illustration of this on the Station. About a month ago we disposed of large quantities of Kikuyu and the patch from which we took the grass three weeks ago was apparently quite clean but now is beautifully green and almost covered with Kikuyu.

" (4) Kikuyu is so aggressive that no other plant can grow with it. This is a great advantage because when planted on the veld it will establish itself against any of our veld grasses of minor feeding value.

" (5) There is a likelihood of a Kikuyu pasture becoming sod-bound and if this should happen, the field should be disked and ploughed or harrowed.

" (6) It is only natural that a plant of such vigorous growth as Kikuyu would soon impoverish the soil.

" Kikuyu responds generously to manure, for where there are animal droppings on a patch it will be noticed the grass grows there higher than anywhere else.

" Lawns have been grown from this grass around the laboratories of the Botanical Division and on the terraces of the Union Buildings, Pretoria. The bright, light green colour of the foliage forms a lovely setting for ornamental gardening. It will also make an excellent field lawn as it forms a dense, soft, and springy turf when closely grazed or clipped.

" On account of its ability to grow on practically any type of soil and its creeping characteristics, it should be an excellent soil binder, on dam walls, on sandy soils and on eroding slopes and dongas.

" Then again it can be recommended as a grass for planting in a poultry-run. Fowls seem very fond of the leaves, and owing to its aggressive nature it can withstand the ravages of the fowls' scratching, &c.

" As Kikuyu is easily propagated by cuttings it may be either planted by cuttings or ' roots.' Our practice is to take the grass out in sod, then cut it up into pieces about 3 inches square and plant it out 6 feet by 6 feet, or 6 feet distant between the rows and 3 feet distant in the rows. Our results have shown that when planted 6 feet by 6 feet on fairly good soil it covers the ground in a single season.

" Kikuyu being a summer grass the best time of planting is during the spring and summer rains, but it can be planted as late as April when the frosts do not occur before May.

" In order to recover the cost of preparing the ground for Kikuyu it is possible after the last cultivation of mealies to put down Kikuyu between the rows."

Subsequently an attempt was made to introduce the grass into Mashonaland. The success seems to have been complete; as may be seen from the following note in the *Rhodesia Agricultural Journal*, vol. XV (1918), p. 327:—

" Kikuyu Grass.—As late as a year ago it was mentioned in an article in the *Rhodesia Agricultural Journal* (June, 1917) that, despite all efforts up to them, no pasture grass had been discovered suitable for Rhodesia which formed a thick bottom and might prove useful for grazing purposes. Since that date, however, our trials with Kikuyu grass (*Pennisetum longistylum*) on the prevailing red soils of Mashonaland have shown that this grass adapts itself perfectly to local conditions, and fulfils all the expectations that have been aroused from reports concerning its behaviour in the Union. The first lot of roots introduced by the Department of Agriculture were obtained from the Potchefstroom experiment farm in March, 1917. Through delays, these arrived in a seemingly dead condition, and after a preliminary soaking were planted out. Practically no rain fell after planting, yet by December, 1917, considerable growth had been made, and the runners became the source of our principal propagation plots. A further lot of slips were imported from Natal in December, 1917, and were planted out one foot apart each way. The slips soon covered the ground entirely, and the growth was so vigorous that the paths and adjoining beds were invaded. The spreading power of this grass is one of its most remarkable features, and not only does it spread along the surface of the ground, but its runners penetrate downwards to a considerable depth in the course of a single season, making its hold upon the ground very firm, and rendering it hardy against tramping. In view of its known excellent feeding qualities, its vigour and its adaptability to Rhodesia, it can be confidently will be available for distribution during the coming season."

INTERNATIONAL RUBBER AND TROPICAL PRODUCTS EXHIBITION, AGRICULTURAL HALL, LONDON, JUNE, 1921.

By D. G. LONGWORTH.

The Exhibition which opened on 3rd June, was excellent in many respects, in fact superior to all previous efforts. The attendance, however, was small, and must be attributed to the present state of the rubber market. Nevertheless, it afforded Brazil and many other extensive rubber producing States an excellent opportunity of advertising their many other valuable products.

South and East Africa were conspicuous by their absence, but the exhibits of the Gold Coast Government and of imports from Nigeria stood out well amongst the many magnificent displays made by the Portuguese possessions, French and Belgian Congo, and the Netherlands

The Fiji Islands Stand, though the smallest in the Exhibition was by no means the least attractive, having the good fortune of being placed in close proximity to the splendid Philippines Stand, thereby enabling their combined forces to attract their full share of attention from visitors.

The Visitors Book at the Fiji Stand contained hundreds of names of visitors from more than thirty different countries all of whom appeared to be genuinely interested in the progress of this Colony. One man who, forty years ago, had spent some time among the Islands was amazed at the samples of wool shown, as in his time he knew of only one scurvy sheep and one horse in the whole country.

Another recent arrival, *via* Vancouver, had completed the journey in twenty-six days. He was most enthusiastic over Suva's new Grand Pacific Hotel and the new steamship service *via* the Panama Canal. The United States and Canada, he said, would be the future home for all the yaka timber the Islands could produce, cattle were doing well; imported meat was a thing of the past, and Australia and New Zealand would, in future have no occasion to suffer for the want of sugar, copra, and fruit.

The exhibit could be made much more attractive if produce were sent from Fiji for the purpose; in addition to the specimens lent by the Imperial Institute and especially if specimens of native handicraft were available for sale at the stand. Many inquiries were received for native cloth, matting, and similar articles.

There was also a great lack of illustrated and descriptive literature. A few Government reports were in no way satisfactory to a lady from Melbourne, who had spent many months amongst the Islands, and has gone so far as to write a book singing the praises of the Fijis and their charms. "The Mediterranean as the yacht's play ground was a fallacy compared to the South Sea Islands, and why lay such stress on 'health notes.' No such thing as malaria exists, and the health question might be easily dismissed by saying that the conditions compared most favourably with other tropical climates. Globe-trotting tourists little knew what they were missing in over-looking the facination of these restful and forgetful Islands." A visitor who had spent several years there agreed with her, but complained bitterly of the ways and means of obtaining land, also that the native was averse to working, and the wages demanded by the Indian labourer were absolutely prohibitive.

The opinion generally expressed was that the Fijis were too far away for the man of modest means. To the capitalist, however, there were opportunities for the development of this little-known country. The average

man associated the Islands with cannibals, &c., being quite ignorant of the progress of the past few years. Propaganda, in the form of attractive literature should be issued, with a view to attracting not only the capitalist, but also the tourist, who is a most valuable asset in point of publicity,

PICKLING LEMON PEEL.

Take a cask of, say, 30 gallons capacity; clean with steam, or soda and boiling water. Remove the lid, and pour into it 20 gallons of clean fresh water, and for every gallon of water add and dissolve 1½ to 2 lb salt. This should read 10° density, by Beaume saccharometer, and is about strong enough to float a potato. The brine is improved by being boiled, which tends to the prevention of mould. Sea-water if convenient, may be used.

The lemons are now cut longitudinally (this may be a matter of choice, but the appearance is certainly in favour of it), and the pulp removed by aid of a pitting spoon. The peel is immediately placed in the brine until the cask is full, taking care that it is always submerged. The lid of the cask may be placed upon the surface and weighed down with bricks or stones. As a word of precaution, take extreme care not to use at any time iron weights or vessels of iron, as the slightest contact of the peel with iron, stains and turns the former black. The peel remains in this brine for at least a month, whence it is removed, drained, and placed in a cask containing fresh water for two days longer, during which the water is changed once.

STONE JARS.

Glazed stone jars are the best for holding the peel during the time it is in the syrup, as, with wooden casks, there is always a certain loss of liquid which does not occur when stone jars are used.

It will be found upon examination of the peel before placing it in fresh water that the brine has acted upon any remaining pulp within the cups, causing it to be soft and pulpy. This can easily be removed with the thumb before placing it in the fresh water, and in fact it has been found that the pulp is so much more easily removed after soaking that it is almost as well not to remove it before placing in the brine, unless the juice of the fruit is required for use.

The same precaution must be adopted with regard to keeping the peel below the surface of the fresh water. At the expiration of two days the fruit is removed, and placed in the cooking kettle, containing cold fresh water, which is raised to boiling point, and the whole simmered for five minutes until the peel is well softened, which in the case of lemons, will usually be in five minutes, while citrons and oranges are better with from thirteen to fifteen minutes' simmering. From this the peels are taken and washed in cold fresh water, to be immediately spread on draining trays, the cups being turned downwards. This is merely to drain off the water and any superflous moisture; half an hour is generally sufficient. They may be placed in the sun, as shown, if the weather is cool. When sufficiently dry, the peel is placed in stone jars or wooden casks, containing cold syrup at a density of 16° Beaume. There it remains for two days. By this time the peel will have absorbed much of the sugar from the syrup thereby lessening the density which must be increased to 18° and the peel allowed to remain in this for another period of two days, at which time the density is again increased by 2° and so on at periods of two days until the density has reached 28° Beaume; then the syrup is drained off, and the peel immersed in syrup

of a density of 32°—where it may remain as long as desired. The addition of a little glucose at this stage will enhance the appearance of the finished article. When the peel has reached this stage—32° Beaume—it should be tested at the end of the first week to see whether or not it is absorbing the sugar, because if so the syrup will require to be again drawn off and brought back to a density of 32°, until the peel has ceased to absorb any further sugar, after which it may be allowed to remain as previously stated for as long as is desired, ultimately being removed and drained upon the syrup table. It is now dried in the shade, or in an evaporator at a temperature not exceeding 100° Fahr. When the peel feels just a little moist to the touch, it is sprinkled with granulated sugar, and allowed to stand a few days before packing in boxes for the market. The resultant weight is about two-thirds of the original lemons before removing the pulp.

CANDIED PEEL.

The following recipe may be found useful:—Cut the peel into quarters lengthwise, remove the juicy portion and throw the peel into salt-and-water brine strong enough to float an egg, and allow it to remain in this for six days. Remove from this and put into clean, cold water, and allow to stand for one hour. Then put into a copper preserving pan, with as much fresh cold water as will cover the peels, and let them boil until quite soft. As soon as a silver fork will go easily into them they are for this stage boiled with only sufficient water for it to absorb. Make just enough of this to merely cover the peels when they are put into it. Again boil them, and continue to boil until the sugar begins to candy. They must then be taken out, and again drained. Before they are quite dry lay them out on large dishes, and shake a little very finely-powdered sugar over them. Set the dishes in a warm place for the peels to dry; when dry they may be stored away for use. Be careful to keep stirring constantly while boiling, or the sugar will certainly burn. A wooden spoon is the best thing to stir with.

MARMALADE.

Crichton's recipe for marmalade is as follows:—Marmalade made from the varieties of the Seville orange is a favourite conserve, and its use is general. The sweet kinds may also be used for the purpose, but they are not nearly so good as the others. An excellent marmalade can be made from the cumquat, as also from the lemon, citron, sweet lemon, and shaddock. In making marmalades with Seville oranges it will be necessary to use an equal weight of sugar and fruit. The oranges are first cut into halves or quarters and boiled for about two hours till the rinds become soft. When sufficiently tender pour off the water, which should be reserved, and slice the fruit, rind, and pulp into fine shreds. Make a syrup in the proportion of 2 lb of sugar to a quart of water. Let the fruit soak in the syrup for about six hours, then simmer for half an hour and boil briskly till the material jellies. The water from the first boiling should be used in making the syrup. Precisely the same directions can be given for making lemon, sweet lemon, citron, or shaddock marmalade, but the first-named fruit requires a larger proportion of sugar.—*Farmers' Bulletin, Department of Agriculture, New South Wales.*

PRESERVED GINGER.

Select young tender roots and clean with a stiff brush, scrape off the skin with the hands in water to avoid iritation of hands and eyes. Put in a large kettle with abundant water. Boil ten minutes. Pour off water, add fresh water and one teaspoon baking soda. Boil fifteen minutes and pour off water. Repeat the boiling in fresh water, without adding soda, until the ginger is tender and has the desired strength, then weigh the ginger add an equal quantity of sugar by weight, and add enough water to cover. Let simmer for two or three hours. Pack in jar and fill to over-flowing with syrup. Seal at once.

PAPAW SWEET PICKLES.

Select half grown fruits, rinse, pare, and remove seeds. Cut into strips 3 inches by ¾ inch, par-boil until tender. Make a syrup of two cups of sugar, one cup of vinegar, one teaspoon ground cinnamon, one teaspoon ground allspice, one teaspoon whole cloves, half teaspoon of ground nutmeg, one stick of cinnamon and the papaya seeds. Tie the ground spice in double cheese-cloth, put this the whole spices and the papaya seeds into the syrup. Boil five minutes. Add the par-boiled papaya to the boiling syrup and boil until transparent. Cover kettle and set aside for twenty-four hours. Then strain, re-heat and bring to a boil; pack in jars filling to overflowing with hot syrup. Seal at once.

SPRAY WASH FOR VEGETABLES.

Take 20 lb of resin, 4 lb caustic soda (98 per cent.) or 6 lb (70 per cent.), 3 pints of fish oil or 2½ lb whale oil soap, and 140 to 150 gallons of water. Place all the above ingredients in a boiler with 20 gallons of the water and let the whole simmer for three hours. Then add hot water slowly and stir well until there are at least 40 gallons of solution. Then add cold water to make up the 140 or 150 gallons. Never add cold water when cooking. This wash, using only 80 gallons of water, will destroy the mussel, glover, and white scales on citrus trees, and the mussel scale of the apple.—*Queensland Agricultural Journal.*

CHOKING.

The Journal of the Jamaica Agricultural Society supplies the following useful information:—

"It is seldom that people know what to do in such cases in the absence of a skilled physician, yet relief may be surely and quickly obtained by pouring the white of an egg (raw), down the sufferer's throat.

"This remedy never fails because the egg will slip down the throat and render the obstruction so smooth that it will readily pass on down. This remedy is just as effective for animals as for human beings. To administer the dose to an animal however is not always easy. The correct way is to place the white of the eggs in a bottle, raise the animal's head, thrust the bottle well back over the tongue, and empty."

ELEPHANT GRASS, OR NAPIER'S FODDER.

By E. Breakwell, B.A., B.Sc., Agrostologist.

It is a native of tropical Africa, being confined to the area between 10 deg. north latitude and 20 deg. south latitude. Within this immense area it occurs mainly along watercourses and in marshy depressions, but also enters the bush and forests where open spaces afford sufficient light. Under favourable conditions it forms extensive reed jungles, as for instance in the delta of the Zambesi. In the interior of Sierra Leone, it ascends nearly to 2,700 feet, and near its southern limit, in Rhodesia, to 5,500 feet. In rich marsh land it attains a height of 21 feet or more, whilst on drier soils, as in the savannas of East Africa, its stalks are hardly more than 6 feet high. In Togoland it has been called Elephant Grass by the colonists, while in Rhodesia it is termed Napier's Fodder, after Colonel Napier. The first mention of the grass was made in 1905, when it was stated to be a good fodder for cattle. Pigler in 1908 described it as one of the best fodder grasses. (*Kew Bulletin*, 1912.)

The Rhodesian Agricultural Department commenced to take up its cultivation in 1910, Colonel Napier co-operating. The latter tested it under severe conditions, and became fully convinced of its economic value.

A parcel of seed was obtained by the Agricultural Department in this State in 1914, and only one seed grew. The resulting single plant became the origin of all the areas now established at the experiment farms, in addition to the thousands of roots distributed to various farmers.

Description.—Elephant Grass (*Pennisetum purpureum*) belongs to the *Pennisetum* family, a near relative being Pearl millet (*Pennisetum typhoideum*). It is a coarse grass, and characterised by extremely rapid growth. Under warm conditions it will attain a height of 20 feet in a few months. It grows in tussocks, and stools considerably. The leaves are 2 feet or more long when fully grown and somewhat coarse, being similar to those of maize. In young plants, however, and in the growths that follow grazing, the leaves are soft and succulent. There is a fair amount of variation in the hairiness of the plant, in some cases the stalks and leaf sheaths being practically glabrous, while in others both are extremely hairy. This variation has also been noticed in Africa in the natural habitat of the grass. The stems, after reaching a height of over 6 or 7 feet, become hard and woody. It has been found by analysis, however, that the feeding value of the mature stalks is comparable to that of maize stalk roughage. In most localities the grass flowers on maturity, but seldom sets ripe seed. On the Northern Rivers and in Queensland ripe seed is formed to a small extent. The flower heads have the characteristic bristles of *Pennisetum*, and are 4 or 5 inches long.

ADAPTABILITY TO SOIL AND CLIMATE.

To date Elephant Grass has shown itself adapted to the coast, tablelands, and the slopes, and in the far west it does well under irrigation. It will grow on all classes of soils, but gives the best results on alluvial, volcanic, or good sandy loams. As a proof of its wonderful aptitude for growing on poor country it may be mentioned that some coastal land just south of Newcastle, previously devoted to burrawang and useless scrub, has now Elephant Grass growing there in abundance, providing a considerable amount of good feed. Good results have also been obtained on barren soils at the mouth of the Manning River, and it should prove useful in bracken or useless scrub country.

Everyone who has grown Elephant Grass has been impressed with the remarkable rapidity with which it develops. In the warm months of the year, if provided with plenty of moisture, it grows over 2 feet a week. Light frosts do not severely affect it, but continuous heavy frosts will kill the flag entirely, though without injuriously affecting the roots, for records from very cold localities show that it readily comes away again in the spring. In western districts it seldom reaches a height of over 6 feet, but stools considerably, a single cutting producing forty or fifty stalks in a single season. As a consequence, it has produced at Cowra Experiment Farm a greater yield for the season than any other grass tried.

That this grass will stand a considerable amount of drought has been proved beyond all doubt at Hawkesbury Agricultural College, Cowra Experiment Farm, and in other localities. Hardly a plant was lost at the College during the great drought, and comparatively few were lost at Cowra during the same period. What Elephant Grass will not endure are the hot winds and the extremely hot surface of the red soil plains in the summer months, and it is hardly worth growing west of Narromine.

Elephant Grass responds to a good rainfall, the conditions most favourable to it being those of the Northern Rivers, but it does not like cold swampy subsoils.

PALATABILITY AND FEEDING VALUE.

The appearance of Elephant Grass is extremely deceptive. At first sight it looks unpalatable, but that it is not so is proved by official investigations under varying conditions, and also by the numerous reports submitted by farmers. Elephant Grass is not as palatable as many other well known grasses, but that cattle will eat it and do well on it is beyond question. Its palatability appears to be greatest in its young, more succulent stages. When it reaches a height of 7 feet or over its woodiness is against it, though even under these conditions the softer ends of the stalks and leaves are readily eaten. Sheep appear to like the grass least of all when other grasses are about, but they will eat it and thrive on it when other feed is not abundant. This has been the experience at Cowra Experiment Farm.

The chemical analysis of the grass was published in the *Agricultural Gazette* in July, 1917, it being shown there that the grass was most satisfactory as regards its food value. Analyses have also been made in connection with the growth that follows grazing and cutting, with the following results:—

	After cutting.	*After grazing.*
Moisture	14·27	13·52
Albumenoids	11·28	11·97
Ether extract	1·65	1·20
Ash	17·55	9·95
Fibre	27·43	31·94
Carbohydrates	27·82	31·42
Albumenoid ratio =	1:2·8	1:2·8
Nutritive value =	42·8	46·0

The results show a slightly favourable margin for the grass under grazing.

MILK PRODUCING QUALITIES.

At Hawkesbury Agricultural College the milk and butter-fat records of eight cows were taken while they were feeding on the Elephant Grass, and also during occasional periods when they were taken off the plot and allowed

to graze on the natural pastures. These recorded twenty-eight milkings while the cows were feeding on the grass, and fifty-five milkings while they were off.

Average Milk Yields and Tests of Cows at Hawkesbury Agricultural College.

	On Elephant Grass.		Off Elephant Grass.	
Number of Cow.	Average milk yield.	Average Test.	Average milk yield.	Average Test.
	lb	%	lb	%
162 ..	15·90	4·70	13·70	4··0
86 ..	13·38	4·98	11·90	5·23
348 ..	17·20	4·18	15·50	4·51
607 ..	15·57	4·91	14·05	4·94
239 ..	13·02	4·68	11·73	4·76
20 ..	11·41	5·22	10·40	5·35
655 ..	12·29	4·44	11·19	4·66
5 ..	10·54	5·21	9·85	5·04

The results appear sufficiently conclusive that the milk yields and butter-fat tests are maintained on Elephant Grass. It might be added that the ordinary pastures of the College were in very good condition at the time the test was carried out.

HOW TO PLANT ELEPHANT GRASS.

Elephant Grass can be raised from seed, but such seed should be sown in a nursery bed, and the young plants transplanted to the permanent paddock. Early summer is the best time for sowing.

The best method of propagation, however, is by planting rooted slips or cuttings. The former can be planted in spring or autumn and the latter in spring only. The slips and cuttings have wonderful vitality, and a case is on record where certain cuttings, having been kept for over a month, were soaked in water before being planted, and a 60 per cent. strike resulted.

Cuttings should be obtained from the fairly-hard portions, and should have three nodes. They should be planted in cultivated ground, at distances of 3 feet apart. The slips can either be inserted in the soil with two nodes in the ground and one out, or shallow furrows can be ploughed 3 feet apart, and the slips or cuttings dropped horizontally in the furrows, and the ridged soil turned back upon the cuttings by reversing the direction of the plough.

CARRYING CAPACITY.

A fodder that will produce 70 to 80 tons of green feed per acre in a season must necessarily have a good carrying capacity. It is very difficult to obtain the actual carrying capacity of the grass, owing to it having to be fed off at intermittent periods. It may be said that when 6 feet high it requires to be very heavily stocked to ensure it being eaten down. The cows should then be removed until the grass has made new growth. In the winter months no growth is made, but during the summer Elephant Grass will maintain ten to twelve cows per acre at periodical intervals.

BEHAVIOUR UNDER STOCKING.

As a rule stock eat the top leaves and stalks of Elephant Grass, and from the joints below several tender shoots spring out, and these are always appreciated.

Owing to its rapid growth in midsummer Elephant Grass often grows quicker than the stock can eat it, and when over 6 or 7 feet high it develops woodiness. Under these conditions a succulent growth can be induced by cutting the grass, not near the base, but a couple of feet above the surface of the ground.

The plants stool considerably, and in the second year it will probably be found that all available room is taken up. Experiments are now being conducted to determine the advantage, if any, of planting the roots at a greater distance apart, and filling up the spaces between with a vigorous creeping grass like Kikuyu Grass.

SUMMARY.

1. Elephant Grass can be treated either as a fodder or as a pasture grass. As a fodder it is not recommended for situations where maize or other summer crops will grow, but it will produce most satisfactory results on poor soils.

2. Elephant Grass should be cut or pastured before reaching a height of six or seven feet; the succulence of the plant improves considerably under grazing.

3. Elephant Grass produces greater fodder yields in our coastal districts than any other plant known.—*New South Wales Agricultural Gazette.*

RHODES GRASS (CHLORIS GAYANA).

Rhodes grass is a perennial grass characterised by an abundant leaf growth and surface runners, which readily root at the nodes. It was introduced into cultivation by Mr. Cecil Rhodes, of South Africa; and appears to have been first grown in this State by the late Colonel Sylvester Browne, of Singleton. It is evident that another grass somewhat similar to it, but very inferior in quality, was introduced about the same time. This is known as *Chloris virgata*, and for some time it was confused with the true Rhodes grass, for the two grasses appear identical during the early stages of their growth, though there is a distinct difference in the inflorescence. The seed spikes of *Chloris virgata* are compressed, scarcely opening out even in the mature stages, whereas those of Rhodes are well extended radially almost as soon as formed. In *Chloris virgata*, also, the seed florets are densely covered with long slender white hairs, very conspicuous in the field, whereas the hairs on *Chloris gayana* are scarcely noticeable.

Soil and Climatic Conditions.—Rhodes grass is now permanently established throughout Queensland and New South Wales, being grown more extensively in the former State than in the latter. It succeeds best on the alluvial or loamy soils, while it grows better than most introduced grasses on the lighter soils, particularly those of granitic or sandstone origin, such as are found in many of our wheat-growing centres and on the coast. It likes

warm situations, and is extremely sensitive to frosts, being completely killed out in localities over 2,000 feet in altitude. It is a favourite grass to sow in "burns" on any part of the coast.

Sowing.—The seed of Rhodes grass is very small and light, and germinates, as a rule, rather badly. The low germination is due to the large number of barren or infertile flowers; and a fertility of 50 per cent., or a total germination of 35 per cent., may be considered very satisfactory for this class of seed. It pays, therefore, to have the land in fine tilth to ensure a good stand, and a farmer should certainly know the fertility of his seed before sowing, in order to plant the right amount. A rough way to determine the fertility is to rub a small amount on the palm of the hand; if the released grain appears plentiful the seed may be considered satisfactory. Only 4 to 6 lb of good seed are required per acre, but 20 lb is sometimes little enough when a large proportion of the seed sown is immature. Broadcast sowing is advocated, and to ensure a good stand half the seed should be sown in a direction at right angles to the other half. In wheat-growing districts the seed can be sown through the wheat drill, if superphosphate or some other substance of the same texture, such as pollard, is mixed with the seed to enable it to run through the drill slowly. Advantage should be taken of favourable weather conditions for sowing, and it is worth while remembering that, although little moisture is necessary to germinate the seed, a fair amount is required to keep the young seedlings growing. When the runners begin to appear the grass can be considered to be well established, and will then stand a fair amount of dry weather. In coastal districts the seed can be sown in autumn up to April, or in early spring, such as in September. The seed will germinate at much lower temperatures than will paspalum. In wheat-growing districts also, September sowing is recommended, or, failing that, March.

Pasturing.—The mistake is often made by farmers of turning the stock on Rhodes grass at too early a stage. The runners take some time to root sufficiently strongly at the nodes to become firmly established in the soil, and early pasturing will pull these runners out of the ground, leaving a space for weeds to encroach on the grass, and eventually smother it. It has been found a good practice to allow the grass to come to seed in the first growth before grazing, and then stock. The leaves are certainly inclined at this stage to be somewhat harsh; but stock generally eat it all down if kept on it. Another alternative is to utilise the first crop for hay, the quality of which is really good. If desired, a crop of the seed can be obtained at the same time. After the first growth the grass can be stocked heavily at any stage, but care should be exercised to remove live stock when the grass is eaten bare.

Rhodes Grass Hay.—Rhodes grass makes excellent hay. Chemical analyses have shown it to possess a high nutritive value, while its aroma and palatability make it very acceptable to stock. The vivid green of the leaves and the fine stems give it a very attractive appearance. It produces heavy yields on the coast, and it is seldom that less than 2 tons per acre are obtained from two or three cuttings during the season. A Queensland report testifies to the fact that Rhodes grass chaff is in demand there, and will bring £10 a ton. Mr. Charles Binnie has also drawn my attention to the result of some analyses of Rhodes grass grown on rather poor soils near Brisbane, as compared with the analyses of a good sample of chaff. They show that even the second cutting of this grass, in the form of hay, has practically double the protein content of wheaten or oaten chaff. It was calculated that 38 lb of Rhodes grass hay are necessary to supply 19 lb of

protein, the average daily requirements of a cow, and that 79 to 85 lb of chaff are required to supply the same amount.

The grass should be cut for hay as soon as the seeds begin to ripen. The curing should be done as quickly as possible, as the strong summer sunshine rapidly bleaches the leaves.

Harvesting for Seed.—Rhodes grass ripens very irregularly, and cutting for seed should be carried out when a fair number of brown seed spikes are noticed in the crop. The protruding anthers render the pollen stage of the seed very conspicuous in the field, and about a fortnight elapses from this period to the hardening of the grain. The ripe seed very easily shatters, and care must be exercised if the best and ripest seed is to be obtained. A good plan is to place tarpaulin inside the wagons and the ripe seeds that fall from the sheaves will then be easily collected. The seeds having been stripped from the sheaves, the latter can be utilised for hay. Many seedsmen winnow the Rhodes grass seed received from growers and sell only the heavy proportion; other less scrupulous seedsmen, however, sell all the seed, which is invariably low in fertility.

Rhodes Grass versus Paspalum.—There is no doubt that paspalum has run riot throughout the greater portion of the coast of New South Wales, mainly because of its remarkably vigorous growth under moist summer conditions, and its habit of quickly spreading throughout river flats and other low-lying areas. That it will carry more stock in ordinary seasons than Rhodes grass cannot be denied, but at the same time it can be confidently stated that it will not maintain stock in as good condition as the Rhodes. Paspalum will grow well in America, yet its cultivation is not recommended by the American Department of Agriculture, while Rhodes grass is strongly recommended for certain localities. Farmers' bulletins have been issued on Rhodes grass, but no bulletin has been published on paspalum. There are many farmers in New South Wales who regret the day paspalum was introduced to their farms, owing to the manner in which it crowds out everything else, its rapid entry into their summer crops, and the manner in which it mats the soil after a few years, and diminished rapidly in carrying capacity and nutritive quality.

Rhodes grass, however, can be grown on any farmer's property, and, if not grazed too strongly, will hold its own with the paspalum. A plot of Rhodes grass at Wollongbar Experiment Farm, with paspalum alongside, has now been growing for some years and hardly a single paspalum plant can be found in the plot. It is a good practice to have the Rhodes grass on the higher ground rather than the lower, because paspalum is most agressive on the flats. A paddock of Rhodes grass on the property of Mr. J. Giblin, Nambucca River, was laid down in 1913, and in spite of constant grazing and cutting is still in splendid condition, and similar results could be obtained on practically any part of the coast.—*Agricultural Gazette of New South Wales.*

NOTES ON THE MANURING OF PINEAPPLES.

By Albert H. Benson, M.R.A.C., Director of Fruit Culture.

In spite of the advice that has been given by the Agricultural Department for many years respecting the manuring of pineapples, many growers still fail to realise that the pineapple plant requires special manurial treatment which will provide an ample supply of the essential plant foods in a form that will enable it to utilise them to the best advantage.

Experience has taught us that the success of pineapple culture does not depend so much on the richness of the soil as on its being in a good mechanical condition and possessing good natural drainage. Such a soil is naturally warm, and if the situation is suitable is not likely to be subject to frost. The good mechanical condition of the soil encourages root formation, and if the soil has been well prepared, deep rooting; so that the feeding roots of the plant have a much larger area from which to obtain their supply of food than is the case when the majority of their feeding roots are near the surface.

Such a soil responds readily to the application of manure; consequently it is of the greatest importance to make sure that the manures applied to develop the pineapple crop are applied in the right form and that they contain their plant foods in the proper proportions required by the plant. Manuring carried out on any other lines is simply a waste of money, as it is no use to apply a manure containing an excess of one plant food and a deficiency of others. A manure containing an excess of any particular plant food is not an economical one to use, especially where there is an excess of phosphoric acid, as the excess of this plant food cannot be made use of, and as a result it is either washed out of the soil by heavy rain, or, unless there is an excess of lime present, it forms insoluble salts of iron and alumina which remain in the soil in an unavailable condition.

The great fault with the majority of commercial fertilisers with respect to their suitability as a manure for pineapples is that they contain a large excess of phosphoric acid that is not required by the plant and which is out of all proportion to the amount of its potash and nitrogen contents. As a result, such manures are bad buying on the part of growers as, on account of their badly balanced composition, they cannot be made use of by the pineapple plant to the best advantage, and the grower has thus paid for a quantity of plant food from which he will obtain no benefit.

Many commercial fertilisers, in addition to having a badly balanced ratio of plant foods as regards pineapples, also contain these plant foods in the wrong form.

The pineapple plant is very sensitive to any excess of acidity in the soil, and any such soils must have their acidity neutralised by the application of lime before they are fit to grow pineapples; consequently the addition of acid phosphates, such as are contained in a commercial fertiliser in the form of superphosphate, only tend to increase the acidity in the soil and render it less suitable for pineapple culture.

Commercial fertilisers containing superphosphate should therefore always be avoided as a manure for pineapples, and growers should be careful not to purchase any fertiliser in which the phosphoric acid is said to be water soluble on the tag attached to the bag or on the invoice. Phosphoric acid should be in the citrate soluble form, such as occurs in bones, meatworks manure, finely ground island phosphates rich in carbonate of lime, basic slag, or basic superphosphate, or it can be present in a less soluble form which will become slowly available. Growers should therefore see that the phosphoric acid as stated on the tag or invoice is citrate soluble or insoluble, the larger proportion being citrate soluble.

The potash contained in the fertiliser should be in the form of sulphate, if procurable, as experience has shown that in this form its use has proved very beneficial; at the same time, the use of the muriate or chloride has so far shown no ill-effects.

The nitrogen contained in dried blood, bone dust, or meatworks manure has given very good results, and when procurable, dried blood is probably the best form in which to apply this plant food. The price is, however, very high, and sulphate of ammonia has, therefore, taken its place in the majority of complete commercial fertilisers, and, when used in the right proportion has given good results. Nitrate of soda is also a good form in which to apply nitrogen, but from my experience it is better to apply this manure as a top dressing by itself rather than to use it as a component part of a complete fertiliser. The growing of a green crop for the purpose of providing a supply of nitrogen must be watched very carefully, as there is always the danger of rendering the soil acid by turning in large quantities of green material which generates acidity during the process of decomposition. Should this take place, the addition of lime to the soil will soon correct the acidity.

Many manurial experiments were carried out by the Department some years ago on pineapples growing on different classes of soils in the Brisbane District, and the result of those experiments is contained in the advice I have just given and the correctness of which has again been proved by a number of manurial experiments that have been carried out at Beerburrum, both on the State farm and on soldiers' holdings, where it has been shown conclusively that the majority of commercial fertilisers contain far too great a proportion of phosphoric acid in comparison with their potash and nitrogen contents, and, further, that the application of phosphoric acid in the form of superphosphates or water soluble phosphoric acid is distinctly injurious to the pineapple plant and is the cause of "spiking," viz., the production of narrow leaves indicating the weakened vitality of the plant.

A complete manure in use at Beerburrum, which has given very good results, contains approximately 4 per cent. of phosphoric acid, citrate soluble, 14 per cent. of potash in the form of sulphate, and 7½ per cent. of nitrogen in the form of dried blood, and this mixture is applied at the rate of 750 lb to the acre during the months of August, September, and February. If these figures are compared with those of any complete commercial fertiliser on the market, it will be seen how small an amount of phosphoric acid is used as compared with that contained in the commercial article, and what a large amount of nitrogen and potash is present. This shows conclusively that growers are wasting money by applying an excess of phosphoric acid to their pineapple crops, and that the money so spent would have been much more profitably invested in the purchase of the nitrogen and potash that their crops needed.

The results obtained at Beerburrum bear out, as already mentioned, those obtained by this Department some years ago; and, further, they are in accord with the requirements of the pineapple plant and fruit as shown by chemical analyses. A careful perusal of these analyses discloses the fact that the pineapple plant and fruit require twice as much nitrogen and more than twice as much potash as they do of phosphoric acid.

Growers will therefore see that it will pay them to apply the right manure to their pineapple crop, and that they only waste money by purchasing manures containing an excess of a plant food which this crop is unable to make use of.—*Queensland Agricultural Journal.*

BANANA CULTURE.

By W. J. Allen and Reg. G. Bartlett.

THE SELECTION OF SUCKERS FOR PLANTING.

One of the most important points in the growing of bananas is the selection and proper treatment of suckers for planting. Unfortunately it is a factor to which very little attention is given by the majority of growers. One hears a good deal about the selection of seed maize and the grading of seed wheat, and of the increased returns and general improvement that arise therefrom, but one does not meet many banana growers who recognise the close relation that careful selection of suckers bears to the future life of a plantation, not alone in regard to the yield of fruit, but particularly as to freedom from disease.

Too often we see suckers taken from abandoned plantations for the simple but very unsatisfactory reason that they are cheap and easy to dig out. The grower knows nothing of the history of such a plantation, nor why it has been unprofitable and has had to be abandoned. A case in point occurred quite recently. A plantation had been abandoned nominally because it had become infected with bunchy top, but when examined it was found that the suckers were positively riddled by beetle borer. An unsuspecting grower might conceivably have decided to select suckers from such a plantation by taking plants that bore no signs of bunchy top, but he would undoubtedly have introduced beetle borer into his new plantation. The intending grower should know not only that his suckers are free from disease and pests but that they come from clean plantations.

It can be readily understood that in the early days of the industry, when the supply of available suckers was scanty, growers had to take what they could get, and the unsound practice arose of planting anything and everything in the shape of a sucker—even to splitting up old butts into four and sometimes six "slips." In many instances—it is hardly too much say, in nearly every one seen—bunchy top has developed on plants raised from butts split into small parts, perhaps because of the extent of cut surface exposed by this method to the action of fungi and bacteria in the soil. Growers will do well to take warning and pay careful attention to this important matter of selecting the right class of sucker.

SELECTION FOR VIGOUR.

Most growers know that the most vigorous sucker is the one with a good bulb and with small narrow leaves. This type of sucker is always a good grower and always produces a good bunch of fruit. The size of the sucker is of less importance than the size of the bulb. The bulb is simply food stored up; hence the larger the bulb the larger the quantity of food stored up to tide the plant over the shock of removal and to enable it to put forth roots in its new abode. Suckers with poor bulbs and trunks of uniform girth should be rejected, and those with good bulbs and tapering trunks, or as some describe them "bottle-shaped," should be preferred. In this way vigorous plants will be obtained that will make the best of the soil and weather conditions.

One of the most vigorous plants of all, of course, is produced from the old butt from which all but one or two eyes have been pruned away. This gives the young plant plenty of food, and enables it to overtake larger suckers and to produce a larger and better bunch, and at a time when prices are good.

Let it be repeated, however—do not split your butts into small pieces making four or six sets or slips, for how then can you get vigour, and how can the plant resist the intrusion of disease with such an extensive cut surface ?

SELECTION FOR DISEASE RESISTANCE.

If the suggestions made above are adopted the grower will plant few diseased bulbs. There is still a chance, however, that suckers will be planted that are not free from root disease, for once introduced into a plantation it can never be eradicated. The grower requires to be extremely careful, therefore, that he does not permit it to come into new areas with his plants. Fortunately its presence in a sucker can be readily discerned by examining the butt. If the butt is cut across with a sharp knife reddish pin spots will be noticed—an unfailing indication of the presence of root disease. Sometimes, if the disease is very marked, it will be found that the rot of the roots has extended fully half an inch into the bulb itself. If, therefore, these symptoms are found in any of the suckers in a field, all suckers in that field should be rejected for the purposes of planting a new area.

Again, beetle borer may be present in a plantation. All suckers intended for planting should be examined to discover whether they show any sign of a hole—in fact, thin slices may be removed from the outside of the bulbs, and if holes are found with material resembling sawdust in them it may reasonably be supposed that the borer is present, and that no plants from the plantation should be used in setting out a new area; at any rate, an officer of the Department should be asked to make an examination.

Nematodes are the curse of plantations not on basaltic soils. They manifest themselves by gall-like swellings or nodules on the roots and by red discolorations that are seen when the roots are split along the length. If these pests are present all suckers should be carefully freed from soil and all roots absolutely pruned off to the bulb. The bulbs should then be soaked for at least two hours in a solution of corrosive sublimate. The strength of the solution should be 1 to 1,000—or 1 ounce corrosive sublimate to 6¼ gallons of water—and it should be contained in a wooden vessel. The mixture is cheap (the corrosive sublimate is about 1s. per ounce) and it may be used over and over again so long as there is sufficient fluid left to cover the bulbs properly. As corrosive sublimate is a deadly poison it must be handled with care, and troughs containing the solution must be covered. No harm is done to the suckers if they remain much longer than the two hours in the solution. Indeed, a grower may dig the holes for a batch of suckers while soaking, and then remove and plant them while the next batch is soaking in its turn, even so long as overnight for next morning's planting.

PLANTING SUCKERS TOO CLOSE.

One of the common errors of banana growers in this State is to plant too close. In Queensland the distance apart that is generally accepted is 12 feet by 12 feet—a method that allows of a citrus orchard being established on the same ground at the same time, with the trees 24 feet by 24 feet apart. Under the conditions obtaining in this State, however, the districts in which bananas are grown have not so far proved suitable for citrus, and this has permitted the space to be reduced appreciably. The system of leasehold tenure has acted in the same direction, it being necessary for the tenant to get as much as possible out of his ground during the short currency of his lease. Moreover, close planting means less weeding, and consequently less expense in cultivation, for the leaves cover the ground, shutting out the light and smothering the weeds.

The grower must take into account, on the other hand, the fact that close planting tends to make the plant grow abnormally tall and to become brittle, with the result that the bunches drop off before they have matured. Further, too dense a shade during humid spring weather favours the development of fungus troubles of different kinds, such, for instance, as " cigar-end," a diseased condition that is more prevalent here than in Queensland.

On the whole, 11 feet by 11 feet may be considered a happy medium in New South Wales; 10 feet by 12 feet gives greater convenience, perhaps, in cultivation where horse implements can be used.

To the care exercised by Queensland growers in the establishment of their plantations must be attributed the long life that is common there; cases are well known in that State of plantations twenty to thirty years old that are still productive, though never replanted. There is no reason why, with good cultivation and attention, they should not live to a good age here also.

DEPTH OF PLANTING.

Many mistakes have been made in this important matter. The grower should recognise that the habit of the banana is to send out roots at a uniform depth of 3 inches below the soil level. This is a fact the importance of which has to be recognised. Whether the bulb is large or small, whether it has been planted deep or shallow, its natural tendency is to throw out its roots at that depth. Its significance lies just here—the grower should plant his suckers with only 3 inches of soil above the top of the bulb. In other words, a sucker with a 3-inch bulb will be planted 6 inches deep, and one with a 12-inch bulb will be planted 15 inches deep. Where obedience to this method means that the hole cannot be filled in it should be " dished off," so that it may be filled in gradually by cultivation, rain, &c.. after the roots have developed at the right point.

It must not be concluded from this that shallow holes should be dug for small bulbs. In every case the hole should be at least 15 inches deep, and the bottom should in addition be broken up with a pick or mattock. The bulb is then set on this loose bottom, a few inches of soil being thrown in in the case of small bulbs; the soil is finally filled in over the bulb so as to give the 3-inch covering referred to.

The importance of this will be seen if we point out the effect of planting too deep. It has been observed often, that if a sucker is set too deep, instead of rooting from the bulb (the natural place) it sends out roots from the stem by splitting the trunk at 3 inches below the surface, and forming a sort of false bulb at that level, while a constriction develops below which makes it impossible for the plant to utilise the plant food stored in the proper bulb. This, of course, means that the sucker is at a standstill until such time as the false bulb and roots have developed, which involves serious loss of time during the growing season and results in a plant distinctly weaker than it might have been.

We cannot too strongly stress the care that should be exercised in planting the top of the bulb at no greater depth than 3 inches below the soil level. Sometimes it is even necessary after a severe rainstorm to go round and remove some of the soil that has been washed in, covering the bulb to a greater depth than the correct one.

PRUNING OR SUCKERING THE BANANA PLANT.

Pruning—or suckering, as it might just as well be called—is neglected by some, and imperfectly understood and practised by others. Some growers

are content to give little attention to it, while others either do it to excess or at the wrong time.

Pruning is carried out for three principal reasons:—

1. It conserves plant food.
2. It results in larger branches and better fruit.
3. It ensures fruit when prices are high.

The removal of such suckers as are not required to produce the crop of fruit is necessary, and should be done when the suckers are not more than 1 foot high. The larger the sucker grows the more food it takes from the parent bulb, and the more do its young roots interfere with the roots of the parent sucker, a reduction in the size of the bunch of fruit being the ultimate result.

It has been proved often enough that the more suckers there are to a stool, the smaller will be the size of the bunches, and the longer will it take for the suckers to mature fruit. The reason is palpable—the suckers are competing with the mother plant for plant food in the soil, and are actually partly fed by it.

The influence upon the price obtained from the fruit is even more interesting Growers generally are content to market their crop every month and any month in the year, without much attempt to regulate the bearing season. It will be admitted, however, that the height of the summer—the end of December and the whole of January and February—are the least profitable months of the year for bananas. If a pruning method can be adopted that will bring along a larger crop in the better months of the year it will obviously be in growers' interests.

If pruning is to be carried out to the best advantage it must not be earlier than January or February. It is a grievous and expensive mistake to do the work earlier in the spring. No doubt it looks reasonable, at a time when the suckers are drawing heavily on the plants, to reduce their number, but as a matter of fact the plant is then in such a vigorous condition that the effect of pruning is to force out an extra growth of suckers, with the result that more labour than ever becomes necessary later in the summer to cut these out. Had the pruning or suckering been delayed until January or February no further suckers would have developed, and one pruning would have sufficed.

Great care should be taken when pruning not to injure the mother plant or its roots, and to this end the spud-bar should be forced only half way through the bulb of the sucker that is to be taken out, and then a gentle levering action will break it off without damaging the parent plant. The hoe and the mattock are not recommended for the operation, owing to the damage they cause to the main root system. Moreover, the remaining portions of suckers so removed are likely to grow again and thus make double work.

A handy and effective tool for the purpose can be made by any blacksmith out of round 1 inch iron, 4 feet long; a blade 8 inches long and 2 inches wide is drawn out at one end, and a 4-inch diamond point at the other end.

Surplus suckers may be most effectively dealt with by cutting off close to the ground with a sheath knife and piercing the centre of the stump with the point of a knife, gouging out the heart. Fluid collects in the hole and prevents further growth without any other injury to the plant. This, of course, only applies when the suckers removed are not required for planting.

It is generally found most profitable to have only three main suckers forming a stool, with three " followers " (small suckers) to take their places. As each parent sucker in an established field will produce from three to five suckers, choice must be made as to which shall be left as the " follower," and it is there that individual judgment is necessary. As a general rule the

following kinds of suckers should always be taken out, because none of them will produce a large bunch:—(1) Those situated inside the triangle formed by the original suckers of the stool; (2) those with broad, flat leaves, often called umbrella or water suckers; (3) those small ones, 4 to 12 inches long, to be found on stumps.

In selecting the suckers to be retained, preference should be given the following:—(1) The sucker with the largest bulb; (2) the sucker farthest from the parent (this ensures room for development); (3) the most pointed sucker with narrow leaves—always a vigorous type of sucker.

The stool should be encouraged rather to spread along the row than between the rows, so that space may be maintained for inter-cultivation with horse implements.

THE LEAVES TO REMOVE.

As the first leaves decay they hang down all round the plant, but they should not be removed during the winter as they afford the plant protection from cold. If carefully cut away at the end of August the sun is better able to get at the trunks and to promote more rapid growth. Too much shade in the growing season is apt to make the stems lengthen out and become brittle. Some growers are too zealous in removing these leaves, however, for they not only cut off dead leaves, but they also remove green leaves, thereby depriving the plant of part of its own machinery for the elaboration of the plant food obtained from the soil. It is safest only to remove those leaves that are actually dead.

Old suckers, from which the branches were removed some little time back and which were allowed to remain as protection for the stools during the winter, may also be got rid off as the weather becomes milder (say the end of August), providing the leaves are quite dead. This can be done with the tool already described. The blade is driven horizontally into the old sucker close to the ground at its junction with the bulb, and is then used as a lever while the head of the sucker is simultaneously pushed over with the left hand. The operation only takes a few seconds, once a little practice has taught the operator just where to drive in the bar.

DEEP CULTIVATION.

The first year of cultivation is the most critical, and entails the heaviest work. Keeping down weeds, maintaining the surface mulch, and loosening the soil, are all important in the cultivation of bananas. Owing to the nature of New South Wales plantations, which, in the majority of cases, are on steep, stony hillsides—to get above frost level—ordinary methods of cultivation are unsuitable. Still, it cannot be too strongly emphasised that deep cultivation is necessary at the right time, with modifications according to the conditions.

In the spring all plantations should, where possible, have the soil deeply loosened, either by deep scarifying or by deep hoeing or mattocking, but this should only be practised when the plants are in vigorous growth—such as occurs after a good rainfall.

The more the soil is loosened and broken up the greater will be the feeding area available for the plants to work on; and, of course, the roots get a better chance to search for food. Some growers may object to this treatment on the ground that it destroys too many surface roots; but it has been proved that deep cultivation in addition to sending roots down to greater depths, also encourages the formation of vigorous feeding roots where the roots have been pruned by hoe or cultivator.—*Agricultural Gazette of New South Wales.*

DEPARTMENTAL NOTES.

There are several articles in this issue of the Circular on the subject of dried bananas, the operations in which have been carried out mostly on a small scale. The information is of value as instructions to householders who wish to prepare small quantities of dried bananas. The conditions of what are termed the dry areas of Fiji are more favourable for the production of commercial quantities of dried fruits, as in the wet zones difficulty will be experienced in combating the excessive humidity of the atmosphere. Although the major part of the natural moisture of the fruit is extracted by evaporation much difficulty will be experienced in wet districts, such as Suva, in preventing the fruit from becoming mouldy. Even if again dried the flavour and appearance will be adversely affected, if attacked by fungus after evaporation. The drying apparatus can be kept free from fungus by the occasional use of sulphur fumes.

The disease of coconuts known as " budrot " having been declared by His Excellency the Acting Governor to be a disease in accordance with Regulation 12 under section of the Diseases of Plants Ordinance of 1913, he directs that trees or plants affected with such disease shall be immediately destroyed and disposed of in such manner as shall be directed by the Superintendent of Agriculture or by an Inspector of Plantations authorised in writing by him for that purpose, and if such directions are not immediately carried out by the owners of such trees or plants such trees or plants may be destroyed forthwith by such Inspector at the expense of the owner and disposed of in such manner as such Inpsector thinks fit. The following description will assist planters to identify the disease:—The last opening leaf fails to open properly and droops over. Sometimes this and the surrounding leaves have some or all of the pinnæ or leaflets crinkled in a " concertina like " way. The heart of the crown is more or less diseased and rotten, in some cases this condition existing for a couple of feet down the trunk. The bud itself is rotten and filled with brownish slime having a foul odour. As no remedy for the disease is known in any of the countries in which it occurs the destruction of affected trees is necessary by cutting down and burning the diseased portions, where practicable, or by burying them with lime.

Owing to the discovery of Rhinoceros Beetle in one of the islands of the Tongan group the importation of all fruits, plants, &c., from that country is prohibited.

Under Proclamation No. 21 of 1921, the exportation from the Colony of all parrots killed, wounded, or taken in the Colony, and of the plumage of all parrots so killed, wounded, or taken is prohibited except with the written consent of the Colonial Secretary.

At the Fifth International Exhibition of Rubber and other Tropical Products recently held in London, a Diploma of Honour was awarded by the Exhibition Authorities to the Government of Fiji. This is expected to arrive at an early date.

Advice has been received from New Zealand in regard to the export of citrus fruits from Fiji to that country. The shipment of oranges and mandarins will be permitted under similar conditions to last year. Intending shippers will be required to advise us as to how many cases they will desire to ship and quarantine accommodation will be allotted in proportion to space available. Special cases will be advisable, a specimen of which can be viewed at this office. All fruit will have to be on the wharf eight clear days before the ship is due to sail. Intending shippers are requested to call at the Department at an early date in order that arrangements may be made. Only close skinned varieties of mandarins will be accepted. Oranges should be cut or picked about a week earlier and be subjected to the influence of sun heat to reduce the skin moisture. The New Zealand Authorities inform us that they propose to amend the regulations in order to allow the importation of limes under the same conditions as lemons. Shippers are advised that this fruit is but little known in New Zealand, so that it would be advisable to ship only the smallest quantity and gradually increase as its superiority to the lemon becomes known. Otherwise the market may be glutted and failure may result.

PRODUCE INSPECTOR'S REPORT.

Bananas exported.—To New Zealand: bunches, 7,433; cases, 81,823; total bunches, 171,079.

Other exports.—To New Zealand: pineapples, 3,860 cases; kumalas, 330 sacks; water melons, 544.

Plant matter.—To New Zealand: 95 packages inspected, 25 packages fumigated; from New Zealand: nil. To Australia: 61 packages inspected, 20 packages fumigated; from Australia: 327 packages inspected and fumigated, one destroyed. To Honolulu: 2 sacks maize. To Vancouver: 11 sacks coconuts. To Tonga and Samoa: 194 packages fumigated; from Tonga and Samoa: 182 packages fumigated.

Inspection of seeds and plants at Post Office.—Number of visits, 10; number of parcels inspected, 44; passed, 42; fumigated, 2; destroyed, nil.

Vessels inspected to and from outlying islands.—Number inspected, 12; packages fumigated, nil; packages destroyed, 1.

Stock inspection.—Imported: sheep, 655; pigs, 49; cattle, 4; horses, 5; dogs, 4; poultry, 94. Exported to Tonga: cattle, 72; parrots, 16. To Sydney: parrots, 3.

ANNUAL REPORT FOR 1921.

By E. S. GORDON, Inspector of Produce.

Division of Inspection of Plants and Plantations.—The inspection of bananas and other fruit offered for export is carried on by the Inspector of Produce and an assistant under Regulations made under Ordinance No. XXI of 1906.

Bananas.—During the year 59,761 bunches and 19,754 cases were exported to Australia, and 20,678 bunches and 237,856 cases to New Zealand, making a total of 80,437 bunches and 257,610 cases, or equivalent to a grand total of 595,659 bunches. The output for the year shows a total of 167,229 bunches less than 1920. This decrease is principally due to the fact that practically no planting has been done for the last three or four years.

For the purposes of comparison the exports per month of bananas for the last five years are given below:—

Month.	1917.	1918.	1919.	1920.	1921.
January	187,758	107,607	43,833	36,861	56,654
February	127,428	69,488	33,654	33,344	41,292
March	112,520	124,485	61,268	84,744	75,933
April	118,602	143,864	36,136	77,504	70,750
May	117,871	86,375	61,661	69,157	53,792
June	102,384	84,382	25,205	68,928	37,176
July	118,044	69,062	36,963	48,332	28,036
August	86,766	63,669	76,308	59,650	29,481
September	38,449	86,249	44,590	94,127	31,456
October	144,373	108,253	63,219	62,863	87,299
November	79,425	112,174	58,121	37,822	34,657
December	119,876	No steamer	73,764	89,556	49,133
Grand totals ..	1,353,496	1,055,608	614,722	762,888	595,659

The total of 1921 is the lowest since 1910, where the amount only reached 433,472 bunches. This however was brought about by the very severe hurricane experienced in March, 1910. As pointed out previously there is no doubt that this very serious decrease in the banana output is due to the fact of no planting having been done for the last few years. This lack of planting has been brought about by the discouragement of both European and native alike, through no steamers being available through strike to take their fruit cargo away, also to a certain extent by the influenza epidemic in 1918, when practically no bananas were cut for some months. Again this year the Australian Government imposed such a prohibitive tariff that it was quite impossible to export any fruit to the Commonwealth.

However, I am glad to say, that at last things look brighter as a new market has been found in Canada and the first trial shipment leaves about the middle of January, 1922. If this market turns out a success, I have no doubt that planting will be taken up extensively by both native and European alike.

Condition of shipment.—The shipments for the year have been anything but satisfactory, especially during the last six months, when serious complaints have been coming forward from New Zealand, due to the fact of a lot of inferior and immature fruit being packed in the cases by the shippers. The Government were accordingly forced to bring in very stringent regulations in regard to the inspection here and there is no doubt that this action has more than justified itself, as the last two or three shipments have shown a very marked improvement.

Prices.—The prices during the year have been quite satisfactory as a whole, especially to those shippers who were selling on a f.o.b. basis, when prices went as high as 15s. per case, during the latter end of the year. However, I am afraid that until the standard of the Fiji bananas is raised considerably very few contracts will be made in 1922.

Freights.—There has been practically no rise in freights during the year.

Pineapples.—A total of 3,860 cases were shipped to all parts and this constitutes a record for many years, which is very satisfactory.

Citrus fruits.—Three shipments of mandarins were forwarded to New Zealand during the year, two of which were condemned for "fruit fly" and the other being allowed to land having been found to be free of "fruit fly." This latter shipment brought splendid prices going as high as 35s. per case. There is no doubt this industry could be worked up to quite an important one, as the Fiji mandarin is in great demand on the New Zealand market.

Other products shipped.—Kumalas, 1,649 sacks; peanuts, 152 sacks; coconuts, 5,654 sacks.

Maize.—Only some 444 odd sacks were exported owing to the shortage of maize in Fiji for the year. In 1920, 1,350 sacks were exported to all ports.

Water melons.—Some 586 of these were shipped as a trial, and I understand brought good prices.

Goods for Samoa and Tonga.—In accordance with the requirements of the Government of these countries, goods such as mats, tappa, and sometimes personal effects are fumigated by the Inspectors in a properly constructed chamber with hydrocyanic acid gas for three hours. A fumigation label is then attached to each article and a certificate issued to the owner, who pays the necessary fee to the Inspector of Produce. This certificate is handed to the steamship company before the articles are allowed on board.

Goods from Tonga and Samoa.—Plant matter from Tonga and Samoa is prohibited in order to prevent the introduction of that serious pest the rhinoceros beetle. All mats, tappa, &c., from Tonga and Samoa are admitted only on the production of a certificate of fumigation from these countries, and as a further precaution are re-fumigated here.

Inspection of imported plant matter.—This work is carried on by the Inspector of Produce and an assistant at Suva, the Harbour Master and Inspector M. A. Forsyth at Levuka, and an Officer of Customs at Lautoka. The inspection is made under Regulations made under Ordinance No. VI of 1913. Several amendments have been made during the year including the total prohibition of apples, pears, quinces, &c., belonging to the natural order (*Rosaceæ*) from the Dominions of New Zealand and Canada and from the United States of America. This Ordinance was brought out in order,

if possible, to prevent the introduction into Fiji of that serious disease known as " fire Blight." As a further precaution all fruit from Australia is fumigated and then carefully examined before delivering same.

As Suva, 651 certificates were issued, representing 29,463 packages, and of these 31 were destroyed and 2,540 fumigated. Thirty-seven visits were paid to the Post Office to inspect seeds, &c., arriving in the mails, 205 parcels were inspected of which 14 were fumigated and 10 destroyed.

METEOROLOGICAL OBSERVATIONS.

Date.	October.			November.			December.		
	Temperature.		Rain.	Temperature.		Rain.	Temperature.		Rain.
	Max.	Min.		Max.	Min.		Max.	Min.	
1	83·8	64·0	..	79·2	71·0	1·20	85·0	69·4	..
2	84·4	63·0	·02	80·2	71·6	..	85·4	69·6	..
3	83·8	63·6	·10	80·6	72·0	..	86·0	70·2	..
4	83·4	68·6	..	81·0	72·4	..	85·2	69·5	·49
5	83·0	68·2	1·55	81·4	73·0	..	85·6	70·0	·30
6	83·6	67·8	·10	81·8	68·8	·35	86·0	69·8	·33
7	84·0	67·4	·54	82·2	68·0	..	85·8	70·2	·42
8	84·4	68·0	..	82·6	68·4	..	86·2	70·6	..
9	84·0	65·0	..	83·2	69·0	..	83·6	69·0	..
10	84·0	67·0	..	83·6	69·2	·40	84·2	70·4	..
11	84·6	66·4	..	83·2	68·8	13·10	84·0	69·0	·01
12	85·0	68·8	..	83·6	69·0	·12	84·4	69·6	1·20
13	84·8	68·4	..	83·6	61·5	·47	82·6	70·0	·75
14	85·2	70·0	..	84·0	62·2	..	84·6	70·4	4·84
15	85·8	70·6	·16	84·4	62·0	..	85·0	70·6	3·75
16	85·8	65·0	..	84·8	63·0	1·10	84·8	70·2	2·25
17	85·4	68·2	·05	85·0	63·6	..	85·4	70·6	2·45
18	85·0	67·6	..	85·6	64·0	..	85·2	70·5	·43
19	85·2	68·4	..	86·0	64·4	·40	86·0	70·8	·90
20	85·6	70·2	..	86·2	68·2	·08	85·6	70·2	1·60
21	86·0	70·4	..	85·8	68·4	..	87·0	70·8	·10
22	86·2	71·0	..	86·0	68·6	..	87·4	71·2	·32
23	83·8	69·4	·05	86·4	69·0	..	87·0	70·8	1·62
24	84·2	70·0	·15	87·0	69·4	..	87·6	71·0	·80
25	84·8	70·4	..	86·8	69·0	·10	87·0	70·2	2·02
26	85·2	71·0	·25	87·2	69·4	·25	80·0	73·0	·15
27	85·0	70·8	·05	83·5	68·0	1·85	80·8	72·0	·73
28	84·6	70·4	·12	83·8	68·2	·45	82·0	74·0	·36
29	84·0	68·4	1·40	84·0	68·6	·40	82·4	73·6	3·58
30	85·0	67·0	·06	84·4	69·0	..	82·8	73·0	..
31	83·2	73·0	·31	..	..	..	83·2	73·6	..
	..	..	4·91	..	..	20·27	..	..	29·40